



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**ECONOMIC ANALYSIS OF POST-TRAUMATIC STRESS
DISORDER (PTSD) IN THE GLOBAL WAR ON
TERRORISM (GWOT)**

by

Boon Wah, Kwan
Lai Yee Irene, Tan

December 2008

Thesis Advisor:
Second Reader:

Yu-Chu Shen
Jeremy Arkes

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 2008	3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE Economic Analysis of Post-traumatic Stress Disorder (PTSD) in the Global War on Terrorism (GWOT)			5. FUNDING NUMBERS	
6. AUTHOR(S) Boon Wah, Kwan and Lai Yee Irene, Tan			8. PERFORMING ORGANIZATION REPORT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A				
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE A.	
13. ABSTRACT (maximum 200 words) <p>This thesis addresses the trend analysis of Post-traumatic Stress Disorder (PTSD) prevalence across the different branches of armed services in the U.S military between FY2001 and FY2006, as well as the effects of deployment characteristics on the probability of being diagnosed with PTSD among the active duty service personnel in the different branches. On top of these, this study will also highlight the patterns of the comorbidity and treatment costs of PTSD across the different branches of armed services.</p> <p>The data used in the thesis will be provided by TRICARE, the Department of Defense's (DOD) health care system and DMDC, to obtain the demographics, deployment characteristics (deployment location, deployment frequencies, deployment duration) and the inpatient and outpatient medical information and services rendered by physicians for all active duty service personnel whom were diagnosed with PTSD between FY2001 and FY2006.</p>				
14. SUBJECT TERMS PTSD, Probit Regression, Deployment Effects, Trend Analysis, Comorbidity, Treatment Costs			15. NUMBER OF PAGES 219	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

NSN 7540-01-280-5500

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

**ECONOMIC ANALYSIS OF POST-TRAUMATIC STRESS DISORDER (PTSD)
IN THE GLOBAL WAR ON TERRORISM (GWOT)**

Boon Wah, Kwan
Lieutenant Commander, Singapore Navy
B.S., University of Illinois at Urbana-Champaign, 1999.

Lai Yee Irene, Tan
Major, Singapore Army
B.A.(Hons), National University of Singapore, 1999

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

**NAVAL POSTGRADUATE SCHOOL
December 2008**

Authors: Boon Wah, Kwan

Lai Yee Irene, Tan

Approved by: Yu-Chu Shen
Thesis Advisor

Jeremy Arkes
Second Reader

Terry Rea
Acting Dean, Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

This thesis addresses the trend analysis of Post-traumatic Stress Disorder (PTSD) prevalence across the different branches of armed services in the U.S military between FY2001 and FY2006, as well as the effects of deployment characteristics on the probability of being diagnosed with PTSD among the active duty service personnel in the different branches. On top of these, this study will also highlight the patterns of the comorbidity and treatment costs of PTSD across the different branches of armed services.

The data used in the thesis are provided by TRICARE, the Department of Defense's (DoD) health care system and Defense Manpower Data Center (DMDC), to obtain the demographics, deployment characteristics (deployment location, deployment frequencies, deployment duration) and the inpatient and outpatient medical information and services rendered by physicians for all active duty service personnel whom were diagnosed with PTSD between FY2001 and FY2006.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	PURPOSE.....	1
B.	RESEARCH QUESTIONS	2
C.	STUDY OVERVIEW AND SIGNIFICANCE.....	3
D.	ORGANIZATION OF STUDY.....	5
II.	LITERATURE REVIEW	7
A.	INTRODUCTION.....	7
B.	DEFINITION OF PTSD, SYMPTOMS AND TREATMENT	7
C.	PAST RESEARCH ON PTSD.....	11
D.	SHORTCOMINGS IN PREVAILING STUDIES.....	14
E.	TRENDS OF PTSD TREATMENT COSTS.....	15
F.	SUMMARY	17
III.	DATA SOURCES AND SAMPLES	19
A.	INTRODUCTION.....	19
B.	DATA SOURCES.....	19
1.	DEERS Data Set.....	20
2.	Inpatient Records of PTSD Population	22
a.	<i>Standard Inpatient Data Record (SIDR)</i>	23
b.	<i>TRICARE Encounter Data – Institutional (TEDI)</i>	24
3.	OUTPATIENT MEDICAL RECORDS OF PTSD POPULATION	25
a.	<i>Standard Ambulatory Data Record (SADR)</i>	26
b.	<i>TRICARE Encounter Data – Non-Institutional (TEDN)</i>	27
4.	DEPLOYMENT DATA FROM CONTINGENCY TRACKING SYSTEM (CTS) FROM DMDC	28
C.	DATA SAMPLES	29
D.	DATA RESTRICTIONS.....	31
E.	SUMMARY	32
IV.	ANALYTICAL METHODOLOGY	33
A.	INTRODUCTION.....	33
B.	RESEARCH HYPOTHESES.....	33
C.	PREVALENCE OF PTSD IN THE ACTIVE DUTY U.S. ARMED SERVICES	35
1.	All Active Duty TRICARE Beneficiaries	36
2.	Active Duty TRICARE Beneficiaries Who Were Ever Deployed Overseas	36
3.	Active Duty TRICARE Beneficiaries Who Were Ever Deployed to Iraq and/or Afghanistan	37

D.	EFFECT OF DEPLOYMENT INTENSITY ON THE PROBABILITY OF BEING DIAGNOSED WITH PTSD	37
1.	Theoretical Model	38
2.	Independent Variables	39
a.	<i>Service Characteristics</i>	39
b.	<i>Demographics Characteristics</i>	40
3.	Model Specification	41
a.	<i>Effect of Last Deployment Location</i>	41
b.	<i>Interactive Effect of Last Deployment Location and Duration</i>	42
c.	<i>Effect of Deployment Location History</i>	44
d.	<i>Effect of Single and Multiple Deployments to the Same Location</i>	45
E.	COMORBIDITY RISKS AND TREATMENT COSTS AMONG THE PTSD POPULATION	46
1.	Comorbidity Risks	47
2.	Treatment Costs	48
F.	SUMMARY	48
V.	DESCRIPTIVE RESULTS AND TREND ANALYSIS OF PTSD PREVALENCE: COMPARISON ACROSS BRANCHES	49
A.	OVERVIEW	49
B.	SUMMARY STATISTICS OF THE DATA SAMPLES – PTSD AND NON PTSD POPULATION	50
1.	Officers and Warrant Officers Population	50
2.	Enlisted Population	52
C.	TREND ANALYSIS OF THE PREVALENCE OF PTSD ACROSS DIFFERENT BRANCHES OF THE ARMED SERVICES	54
1.1.	New PTSD Cases among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers)	55
1.2.	New PTSD Cases among All Active Duty TRICARE Beneficiaries (Enlisted Personnel)	58
1.3.	Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers)	60
1.4.	Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Enlisted Personnel)	62
2.1.	New PTSD Cases Among Active Duty TRICARE Beneficiaries (Officer and Warrant Officer) Who Were Ever Deployed Overseas	65
2.2.	New PTSD Cases Among Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas	68
2.3.	Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed Overseas	70

2.4.	Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas.....	72
3.1.	New PTSD Cases Among Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq	74
3.2.	New PTSD Cases Among Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq	77
3.3.	Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq	80
3.4	Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq	83
4.1	Comparison of PTSD Incidence Across the Study Population	85
D.	SUMMARY	87
VI.	RESULTS OF ANALYSIS: EFFECT OF DEPLOYMENT INTENSITY ON PROBABILITY OF BEING DIAGNOSED WITH PTSD	91
A.	OVERVIEW	91
1.	Model 1: Effect of Last Deployment Location	91
2.	Model 2: Interactive Effect of Last Deployment Location and Duration.....	92
3.	Model 3: Effect of Deployment Location History	92
4.	Model 4: Effect of Single and Multiple Deployments to the Same Location.....	92
B.	DESCRIPTIVE STATISTICS OF SAMPLE FOR MULTIVARIATE ANALYSIS	93
1.	Officers and Warrant Officer Population	93
2.	Enlisted Population	99
C.	RESULTS OF MULTIVARIATE ANALYSIS MODEL 1 – EFFECT OF LAST DEPLOYMENT LOCATION.....	103
1.	Officers and Warrant Officers.....	103
a.	Army.....	105
b.	Air Force	106
c.	Marine Corps	106
d.	Navy	107
2.	Enlisted Personnel	110
a.	Army.....	112
b.	Air Force	113
c.	Marine Corps	113
d.	Navy	113

D.	RESULTS OF MULTIVARIATE ANALYSIS MODEL 2 – INTERACTIVE EFFECT OF LAST DEPLOYMENT LOCATION AND DURATION.....	115
1.	Officers and Warrant Officers.....	116
a.	Army.....	117
b.	Air Force	118
c.	Marine Corps	118
d.	Navy	119
2.	Enlisted Personnel	119
a.	Army.....	120
b.	Air Force	121
c.	Marine Corps	121
d.	Navy	121
E.	RESULTS OF MULTIVARIATE ANALYSIS MODEL 3 – EFFECT OF DEPLOYMENT LOCATION HISTORY	122
1.	Officers and Warrant Officers.....	122
a.	Army.....	123
b.	Air Force	124
c.	Marine Corps	124
d.	Navy	124
2.	Enlisted Personnel	124
a.	Army.....	126
b.	Air Force	126
c.	Marine Corps	126
d.	Navy	126
F.	RESULTS OF MULTIVARIATE ANALYSIS MODEL 4 – EFFECT OF SINGLE AND MULTIPLE DEPLOYMENTS TO THE SAME LOCATION.....	127
1.	Officers and Warrant Officers.....	127
a.	Army.....	128
b.	Air Force	129
c.	Marine Corps	129
d.	Navy	129
2.	Enlisted Personnel	129
G.	SUMMARY	132
VII.	IN-DEPTH ANALYSIS OF THE PTSD POPULATION OF THEIR TREATMENT COST, COMORBIDITY AND OTHER USEFUL CLINICAL INFORMATION.....	135
A.	OVERVIEW	135
B.	ANALYTICAL APPROACH	135
1.	DEFINITIONS OF MEDICAL CLASSIFICATIONS OF PTSD COMORBIDITY DISTRIBUTION AND OTHER NOMENCLATURES.....	136
2.	MERGING OF CLINICAL DATA SETS WITH DEERS DATA FILE ON PTSD POPULATION.....	138

C.	ANALYSIS OF PTSD COMORBIDITY DISTRIBUTION AND TREATMENT COSTS ACROSS SERVICES AT CLAIMS LEVEL..	139
1.1	Officers and Warrant Officers PTSD Population – Inpatient Visits (Refer to Table 7.2)	139
a.	<i>Mental Health Illness Indicators</i>	139
b.	<i>Frequency of Site Visits</i>	143
c.	<i>Average Treatment Costs and Length of Stay</i>	143
1.2	Officers and Warrant Officers PTSD Population – Outpatient Visits (Refer to Table 7.2)	144
a.	<i>Mental Health Illness Indicators</i>	144
b.	<i>Frequency of Site Visits</i>	145
c.	<i>Average Treatment Costs</i>	145
2.1	Enlisted PTSD Population – Inpatient Visits (Refer to Table 7.3)	146
a.	<i>Mental Health Illness Indicators</i>	146
b.	<i>Frequency of Site Visits</i>	147
c.	<i>Average Treatment Costs and Length of Stay</i>	148
2.2	Enlisted PTSD Population – Outpatient Visits (Table 7.3)	151
a.	<i>Mental Health Illness Indicators</i>	151
b.	<i>Frequency to Visit Sites</i>	151
c.	<i>Average Treatment Costs</i>	152
D.	ANALYSIS OF PTSD COMORBIDITY DISTRIBUTION AND TREATMENT COSTS ACROSS SERVICES AT INDIVIDUAL LEVELS	153
1.1	Officers and Warrant Officers PTSD Population – Inpatient Visits (Refer to Table 7.4)	153
a.	<i>Mental Health Illness Indicators</i>	153
b.	<i>Frequency of Site Visits</i>	154
c.	<i>Average Treatment Costs and Length of Stay</i>	154
1.2	Officers and Warrant Officers PTSD Population – Outpatient Visits (Refer to Table 7.4)	155
a.	<i>Mental Health Illness Indicators</i>	156
b.	<i>Frequency of Site Visits</i>	156
c.	<i>Average Treatment Costs</i>	156
2.1	Enlisted PTSD Population – Inpatient Visits (Table 7.5)...	162
a.	<i>Mental Health Illness Indicators</i>	162
b.	<i>Frequency of Site Visits</i>	163
c.	<i>Average Treatment Costs and Length of Stay</i>	163
2.2	Enlisted PTSD Population – Outpatient Visits (Refer to Table 7.5)	164
a.	<i>Mental Health Illness Indicators</i>	164
b.	<i>Frequency of Site Visits</i>	165
c.	<i>Average Treatment Costs</i>	165
E.	ANALYSIS OF DEMOGRAPHICS AT INDIVIDUAL LEVEL – GENDER AND RACE ON THE PTSD COMORBIDITY	166

1.1	Officers and Warrant Officers PTSD Population – Analysis by Gender (Table 7.6).....	166
a.	<i>Inpatient Records</i>	166
b.	<i>Outpatient Records</i>	167
1.2	Enlisted PTSD Population - Analysis by Gender (Table 7.7)	169
a.	<i>Inpatient Records</i>	169
b.	<i>Outpatient Records</i>	169
2.1	Officers and Warrant Officers PTSD Population – Analysis by Race (Table 7.8).....	172
a.	<i>Inpatient Records</i>	172
b.	<i>Outpatient Records</i>	173
2.2	Enlisted PTSD Population – Analysis by Race (Table 7.9)	174
a.	<i>Inpatient Records</i>	174
b.	<i>Outpatient Records</i>	175
F.	ANALYSIS OF DEMOGRAPHICS AT INDIVIDUAL LEVEL – GENDER AND RACE ON THE TREATMENT COSTS AND LENGTH OF STAY	178
1.	Average Treatment Costs and Length of Stay for Officers and Warrant Officers PTSD Population – by Gender (Table 7.10)	178
2.	Average Treatment Costs and Length of Stay for Enlisted PTSD Population – by Gender (Table 7.11)	182
3.	Average Treatment Costs and Length of Stay for Officers and Warrant Officers PTSD Population – by Race (Table 7.12)	185
4.	Average Treatment Costs and Length of Stay for Enlisted PTSD Population – by Race (Table 7.13)	187
G.	SUMMARY	189
VIII.	CONCLUSION	191
A.	CONCLUSIONS	191
B.	LIMITATIONS OF STUDY	193
C.	RECOMMENDATIONS	194
	LIST OF REFERENCES.....	195
	INITIAL DISTRIBUTION LIST	199

LIST OF FIGURES

Figure 5.1.	Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Diagnosed with PTSD between FY2001 and FY2006.....	57
Figure 5.2.	Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Diagnosed with PTSD Between FY2001 to FY2006	59
Figure 5.3.	Cumulative Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Diagnosed with PTSD between FY2001 to FY2006	60
Figure 5.4.	Cumulative Percentage of PTSD Incidence (Officers and Warrant Officers).....	61
Figure 5.5.	Cumulative Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Diagnosed with PTSD between FY2001 and FY2006.....	63
Figure 5.6.	Cumulative Percentage of PTSD Incidence (Enlisted Personnel)	64
Figure 5.7.	Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed Overseas and Diagnosed with PTSD between FY2001 and FY2006.....	67
Figure 5.8.	Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas and Diagnosed with PTSD Between FY2001 and FY2006	69
Figure 5.9.	Cumulative Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed Overseas and Diagnosed with PTSD between FY2001 and FY2006.	71
Figure 5.10.	Cumulative Percentage of PTSD Incidence (Officers and Warrant Officers Who Were Ever Deployed Overseas)	72
Figure 5.11.	Cumulative Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas and Diagnosed with PTSD between FY2001 and FY2006.....	73
Figure 5.12.	Cumulative Percentage of PTSD Incidence (Enlisted Personnel Who Were Ever Deployed Overseas).....	74
Figure 5.13.	Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD Between FY2001 and FY2006	77
Figure 5.14.	Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD between FY2001 and FY2006.....	79
Figure 5.15.	Cumulative Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD between FY2001 and FY2006	80

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 2.1.	Symptoms of PTSD as classified by DSM IV	8
Table 3.1.	Descriptive Statistics of DEERS Data Set Variables	21
Table 3.2.	Details of Frequency of PTSD Treatment at the MTFs.....	24
Table 3.3.	Number of Institutional TRICARE Claims (TEDI) for PTSD Diagnosed Personnel between FY2001 and FY2006.....	25
Table 3.4.	Number of Professional Services/Outpatient Treatment for PTSD Diagnosed Personnel between FY2001 and FY2006.....	27
Table 3.5.	Number of Non-Institutional TRICARE Claims (TEDN) for PTSD Diagnosed Personnel between FY2001 and FY2006.....	28
Table 3.6.	Summary of Observations in the CTS Deployment Data for FY2001 to FY2006.....	29
Table 4.1.	Deployment Duration Interval Definition for the Services	43
Table 4.2.	Categories of Comorbidities for PTSD.....	47
Table 5.1.	Summary Statistics of the DEERS Data Samples of the Four Services (Officers and Warrant Officers).....	51
Table 5.2.	Summary Statistics of the DEERS Data Samples of the Four Services (Enlisted Personnel)	53
Table 5.3.	Summary of TRICARE Enrollment (Officers and Warrant Officers) from FY2001 to FY2006	55
Table 5.4..	Summary of TRICARE Enrollment (Enlisted Personnel) from FY2001 to FY2006	58
Table 5.5.	Summary of TRICARE Enrollment (Officers and Warrant Officers) Who Were Ever Deployed Overseas from FY2001 to FY2006.....	65
Table 5.6.	Summary of TRICARE Enrollment (Enlisted Personnel) Who Were Ever Deployed Overseas from FY2001 to FY2006	68
Table 5.7.	Summary of TRICARE Enrollment (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq between FY2001 and FY2006	75
Table 5.8.	Summary of TRICARE Enrollment (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq between FY2001 and FY2006.....	78
Table 5.9.	Number of New PTSD Case Diagnosed Each Year for Officers and Warrant Officers	85
Table 5.10.	Number of New PTSD Case Diagnosed Each Year for Enlisted Personnel	86
Table 5.11.	Cumulative Percentage of PTSD Incidence for Officers and Warrant Officers	86
Table 5.12.	Cumulative Percentage of PTSD Incidence for Enlisted Personnel....	87
Table 6.1.	Descriptive Statistics of Sample for Multivariate Analyses (Officers and Warrant Officers)	97
Table 6.2.	Descriptive Statistics of Sample for Multivariate Analyses (Enlisted Personnel)	102

Table 6.3.	Marginal Effect of Last Deployment Location and Type on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers).....	105
Table 6.4.	Marginal Effect of Last Deployment Location and Type on Probability of Being Diagnosed with PTSD (Enlisted Personnel).....	112
Table 6.5.	Marginal Effect of Last Deployment Location and Duration on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers).....	117
Table 6.6.	Marginal Effect of Last Deployment Location and Duration on Probability of Being Diagnosed with PTSD (Enlisted Personnel)	120
Table 6.7.	Marginal Effect of Deployment Location History on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers).....	123
Table 6.8.	Marginal Effect of Deployment Location History on Probability of Being Diagnosed with PTSD (Enlisted Personnel)	125
Table 6.9.	Marginal Effect of Single and Multiple Deployments to the Same Location on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers)	128
Table 6.10.	Marginal Effect of Single and Multiple Deployments to the Same Location on Probability of Being Diagnosed with PTSD (Enlisted Personnel)	131
Table 7.1.	Categories of Comorbidities Associated with PTSD	137
Table 7.2.	PTSD Comorbidity Distribution for Officers and Warrant Officers PTSD Population across Services (Claims/Visits level).....	142
Table 7.3.	PTSD Comorbidity Distribution for Enlisted PTSD Population across Services (Claims/Visits level)	150
Table 7.4.	Overall PTSD Comorbidity Distribution and Average Treatment Costs for Officers Population across Services (Individual Level).....	159
Table 7.5.	Overall PTSD Comorbidity Distribution and Average Treatment Costs for Enlisted Population across Services (Individual level)	161
Table 7.6.	Overall PTSD Comorbidity Distribution for Officer Population across Services (Individual Level - Gender).....	168
Table 7.7.	Overall PTSD Comorbidity Distribution for Enlisted Population across Services (Individual level- Gender)	171
Table 7.8.	Overall PTSD Comorbidity Distribution for Officers Population across Services (Individual Level – Race).....	176
Table 7.9.	Overall PTSD Comorbidity Distribution for Enlisted Population across Services (Individual Level – Race).....	177
Table 7.10.	Average PTSD Treatment Costs among Officer Population across Services (Gender)	181
Table 7.11.	Average PTSD Treatment Costs among Enlisted Population across Services (Gender)	184
Table 7.12.	Average PTSD Treatment Costs among Officers Population across Services (Race)	186
Table 7.13.	Average PTSD Treatment Costs among Enlisted Population across Services (Race)	188

ACKNOWLEDGMENTS

We would like to offer our sincerest gratitude to Professor Yu-Chu Shen for her dedicated advice and guidance throughout our thesis research. Her professional inputs and willingness to share her subject matter expertise has definitely made our research more fulfilling and time well spent. We appreciate her assistance in the requisition of the data sets from TRICARE and DMDC.

We would also like to thank Professor Jeremy Arkes for his advice and valuable comments for our thesis.

Last but not least, we would like to thank our spouses Audrey and Hean Chuan for their kind understanding and utmost support, especially in times when the going gets tough.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. PURPOSE

The recent ongoing military operations in Iraq and Afghanistan represent the most sustained ground combat operations involving American forces since the Vietnam era. Since October 2001, approximately 1.64 million U.S. troops¹ have been deployed as part of Operation Enduring Freedom (OEF; Afghanistan) and Operation Iraqi Freedom (OIF; Iraq). The large magnitude of the involvement of military personnel who have gone through high intensity guerilla warfare and the chronic threat of improvised explosive devices (IED) and roadside bombs has resulted in increased incidences of both traumatic physical injuries and mental problems.

Post-Traumatic Stress Disorder (PTSD) has been a leading health problem among the military personnel and veterans who have served in prior wars, with heavy combat typically being cited as a leading cause of PTSD. With the ongoing Global War on Terrorism (GWOT), the rate of PTSD has risen steadily. Based on several studies on the risks associated with the U.S. military, the current estimated risks of PTSD among U.S. Army and Marine Corps personnel from service in OEF and OIF ranged from 10 to 18% (Hoge et al. 2004; Hoge et al. 2006; Vasterling et al. 2006; Hoge et al. 2007; Seal et al. 2007; Martin 2007). There are few existing statistics available for the Navy and the Air Force.

In this study, the term PTSD is used to refer to “combat-related” PTSD that occurs in people who have been exposed to “war-zone trauma.”² This study

¹ Terri Tanielian, Lisa H. Jaycox, David M. Adamson, and Karen N. Metscher. *Invisible Wounds of War—Psychological and Cognitive Injuries, Their Consequences and Services to Assist Recovery*.

² This includes not only traditional combat experiences (e.g., firing a weapon at someone, being fired upon) but also a variety of other events which occur with increased frequency in war zones (e.g., exposure to death and dying, atrocities).

will identify the prevalence of PTSD rates across the different branches of the armed services after their participation in OEF and OIF (between FY2001 and FY2006) and evaluate how deployment characteristics (such as deployment intensity and length) and other risk factors affect PTSD prevalence across the armed services. In addition, this study will provide an in-depth look at the PTSD population among the active duty population, analyzing the comorbidity distribution, the different clinical diagnoses, and the patterns of treatment costs across the different branches of the armed services.

B. RESEARCH QUESTIONS

While past studies have provided important information on PTSD in the GWOT era, they have several shortcomings. This study will attempt to provide military officials and policy makers with better information to address the issue of PTSD in the current environment by examining the following research issues:

- What is the prevalence of PTSD across different branches of the armed services and how is this affected by different demographic characteristics?
- How do risk factors including deployment intensity (such as deployment location and tour length) affect the prevalence of PTSD, and does deployment effects differ across the branches?
- What are the comorbidity risks and treatment costs of PTSD, and are there different patterns to comorbidity distribution and treatment across the different branches?

For the first two research questions, all service members who were on active duty between FY2001 and FY2006 will be analyzed. The final research question will focus only on the PTSD population, i.e., service members who have been diagnosed with PTSD at any time during the study period. Separate analyses will be conducted for each branch of armed services (Army, Navy, Marines, and Air Force) and their results will be compared. For each branch, the enlisted personnel and officers will be analyzed separately.

C. STUDY OVERVIEW AND SIGNIFICANCE

The main empirical strategy for this thesis will be a combination of descriptive statistics and multivariate analytical methods to derive the trend analysis of the prevalence of PTSD, the probability of being diagnosed with PTSD given deployment intensity and other potential risk factors, as well as the comorbidity distribution and total treatment costs of PTSD across the different branches. There will be four main sections to the body of this thesis. The first section will be a review of the current literature on PTSD, especially focused on the effect of active duty personnel's continued exposure to combat conditions as well as the current data that have been gathered on OIF and OEF. This review will also include past studies on the prevailing treatment for the active duty personnel who have been diagnosed with PTSD.

The second section of the thesis will focus on the assessment of the trends of PTSD across the different branches of services from FY2001 to FY2006 (OIF and OEF periods) using data from the Defense Enrollment Eligibility Reporting System (DEERS) provided by TRICARE.

In the third section of the study, the actual deployment data from Defense Manpower Data Center's (DMDC) Contingency Tracking System (CTS), which has recorded deployment information since the start of the GWOT, will be merged with TRICARE data to determine the effects of deployment intensity and other risk factors for PTSD.

The final section of the study will be directed towards the assessment of comorbidity distribution and patterns of the treatment costs of PTSD across the different branches among the active duty population who have been diagnosed with PTSD during the study period. This portion of the study will use the clinical

data in TRICARE inpatient and outpatient claim systems to derive the treatment cost patterns and clinical characteristics across the different branches.³

The rising trend in mental health illnesses, especially PTSD, since the start of the GWOT requires the DoD to be well-equipped to manage a new generation of military service members succumbing to PTSD. Results from the first research question would aid the planners of the U.S military in their understanding of the risk factors for PTSD amongst their active duty personnel. As such, they could better focus their attention on preventive measures for those potentially at a higher risk. Military planners could make use of the information from the deployment analysis in the structuring of the optimal tour length and tour rotation for their service personnel to minimize the risks of developing PTSD. The level of combat readiness of the fighting force would be compromised if potential or current PTSD cases were left untreated or inadequately treated and this could lead to prohibitive social cost. A recent comprehensive study by RAND on mental health outcomes of returning service members from combat zones highlighted that there is a fundamental gap in our understanding of the mental health needs of these returning service members, with PTSD being one of the three major conditions to focus on.⁴ Thus, this study will provide valuable information to aid the DoD in managing the rising trend of PTSD.

³ This includes the Standard Inpatient Data Record (SIDR), Standard Ambulatory Data Record (SADR), TRICARE Encounter Data – Institutional (TEDI) and TRICARE Encounter Data – Non-Institutional (TEDN).

⁴ Terri Tanielian & Lisa H. Jaycox. (2008). *Invisible Wounds of War—Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery*. RAND Corporation.

D. ORGANIZATION OF STUDY

The rest of the thesis is organized as follows: Chapter I offers a brief summary of the increased occurrences of PTSD as the fight for the GWOT continues. Chapter II provides background on the prevailing research on PTSD and its treatment costs. This literature review chapter offers an analysis of past studies on PTSD, in particular, cases of active duty personnel being deployed in combat regions. The chapter also summarizes the clinical diagnosis and treatment costs. Chapter III describes the data sources and the sampling restrictions. Chapter IV lays out the empirical methodology – a combination of descriptive statistics and multivariate analysis models. Chapter V presents the summary statistics and trend analysis of the prevalence of PTSD across different branches of the armed services and different demographic characteristics. Chapter VI focuses on the detailed probit analysis on the effects of deployment intensity on PTSD. Chapter VII provides the in-depth analysis and findings derived from the analysis of the TRICARE inpatient and outpatient claim data on the PTSD population across the different branches of services. In addition, this chapter analyzes whether the clinical characteristics differ across the branches. Chapter VIII comprises conclusions and recommendations and study limitations.

THIS PAGE INTENTIONALLY LEFT BLANK

II. LITERATURE REVIEW

A. INTRODUCTION

Recent research suggests that the wars in Iraq and Afghanistan pose substantial mental health challenges to U.S. military service members, mental health systems, and the public at large. OEF and OIF are protracted engagements with surprise attack settings where it is difficult to distinguish enemies from civilians. Chronic combat-related PTSD leads to a host of long-term family and workplace problems and is often comorbid with other psychiatric and physical disorders.⁵ With the rising trends of PTSD among the active duty personnel in the U.S military, timely detection and intervention with personnel suffering from PTSD should be a high priority.

This chapter provides an overview of the prevailing studies on PTSD symptoms and its treatment costs. Section B begins by defining the clinical definition and symptoms of PTSD. In Section C, literature is reviewed that examines the prevalence and risk factors of PTSD. The way this study advances the literature in this area is discussed in Section D. The existing knowledge of the treatment cost of PTSD is discussed in Section E, and Section F concludes the study.

B. DEFINITION OF PTSD, SYMPTOMS AND TREATMENT

Post-Traumatic Stress Disorder (PTSD) is a psychological disorder that develops following exposure to trauma. Trauma can result from experiencing or witnessing traumatic or life-threatening events such as terrorist attacks, violent crime and abuse, military combat, natural disasters, serious accidents, or violent

⁵ Christopher Erbes (2007). Post-Traumatic Stress Disorder and Service Utilization in a Sample of Service Members from Iraq and Afghanistan. *Military Medicine*, 172(4),359.

personal assaults.⁶ The characteristic features are persistent re-experiencing of the event, avoidance of stimuli associated with the trauma, and symptoms of increased arousal. For the Diagnostic and Statistical Manual of Mental Disorders (DSM) classification, the person must also have experienced intense fear, helplessness, or horror when the event occurred. These symptoms must persist for at least one month, and they must cause clinically significant distress and affect the individual's ability to function socially, occupationally, or domestically.⁷ The characteristic symptoms of PTSD (adapted from DSM IV⁸) are summarized as follows:

Table 2.1. Symptoms of PTSD as classified by DSM IV9

Re-experiencing phenomena (at least one required)
<ul style="list-style-type: none"> • Recurrent and intrusive distressing recollections • Recurrent distressing dreams • Acting or feeling as if the events are recurring • Intense psychological distress to cues • Physiological reactivity to cues
Avoidance and numbing (at least three required)
<ul style="list-style-type: none"> • Avoidance of thoughts, feelings, and conversations • Avoidance of reminders

⁶ Javier Iribarren, Paolo Prolo, Negoita Neagos, and Francesco Chiapelli (2005). Post-Traumatic Stress Disorder: Evidence-Based Research for the Third Millennium. eCAM 2005; 2(4), 503-512.

⁷ Jonathan I Bisson (2007). Clinical Review: Post-traumatic stress disorder. British Medical Journal 2007; 334: 789-793. <http://www.bmj.com/cgi/content/extract/334/7597/789> accessed on 20 Aug 08.

⁸ American Psychiatric Association (2000). Diagnostic and Statistical Manual of Mental Disorders DSM-IV (Text Revision).

⁹ Ibid.

<ul style="list-style-type: none"> • Psychogenic amnesia • Greatly reduced interest in related activities • Detachment or estrangement feelings • Restricted range of affect • Sense of a foreshortened future
Increased arousal (at least two required)
<ul style="list-style-type: none"> • Difficulty sleeping • Irritability or outbursts of anger • Difficulty concentrating • Hypervigilance • Exaggerated startled response

An important component of the epidemiology of PTSD is its patterns of comorbidities—that is, do people who have PTSD also have co-occurring other disorders?¹⁰ Based on current literature, the usual comorbidities that accompany PTSD are major depression, substance abuse, and other anxiety disorders. According to a study conducted by Grieger et al. (2006)¹¹ on a military cohort of hospitalized soldiers who were diagnosed with PTSD between March 2003 and September 2004, about 6.3% of the sample was found to have

¹⁰ William E. Schlenger et al. (1999). Combat-Related Posttraumatic Stress Disorder: Prevalence, Risk Factors and Co-morbidity. In Philip A. Saigh & J. Douglas Bremner (Eds.), *Post-traumatic Stress Disorder: A Comprehensive Text* (pp. 69-91). MA: Allyn & Bacon.

¹¹ T.A., Grieger, S.J, Cozza, R.J, Ursano, C. Cozza, P.E., Martinez, C.C., Engel, & H.J Wain, (2006). Posttraumatic stress disorder and depression in battle-injured soldiers. *American Journal of Psychiatry*, 163, pp. 1777-1783.

depression and PTSD up to seven months after injury. This phenomenon was also evident in the RAND (2008) study, which established that approximately two-thirds of the survey respondents who had been diagnosed with PTSD also had major depression.¹²

Based on the information from the National PTSD Center of the Department of Veterans Affairs, there are different treatments available for PTSD.¹³ One of the treatment methods is Cognitive Behavioral Therapy (CBT), which is a type of counselling to help PTSD patients understand and change the way they think about their trauma and its aftermath. There is also a similar kind of therapy called eye movement desensitization and reprocessing (EMDR) that is used for treatment of PTSD via influencing a change in how a person reacts to memories of trauma. Group therapy is yet another type of treatment for PTSD. In group therapy, all PTSD patients are encouraged to share their experiences with a group of people who also have been through a trauma and who have PTSD. This treatment can help PTSD patients better cope with their symptoms, memories, and other parts of their lives. Besides therapy, medications have also been shown to be effective in the treatment of PTSD. For instance, one type of anti-depressant drug that is known as a selective serotonin reuptake inhibitor (SSRI) has proven to be effective for PTSD, as SSRI raises the level of serotonin in the brain which affects one's emotions.

¹² Benjamin R. Karney, Rajeev Ramchand, Karen Chan Osilla, Leah Barnes Caldarone, and Rachel M. Burns (2008). Predicting the Immediate and Long-Term Consequences of Post-Traumatic Stress Disorder, Depression, and Traumatic Brain Injury in Veterans of Operation Enduring Freedom and Operation Iraqi Freedom. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 119-166). RAND Corporation.

¹³ National Center for PTSD (Department of Veterans' Affairs). Treatment of PTSD. http://www.ncptsd.va.gov/ncmain/ncdocs/fact_shts/fs_treatmentforptsd.html accessed on 31 Aug 08.

C. PAST RESEARCH ON PTSD

The epidemiology of combat-related PTSD is the study of the occurrence of PTSD in human populations and includes the prevalence of PTSD (i.e., what proportion of a specified population has the disorder in a given time period), how PTSD relates to other disorders (i.e., comorbidities), and what risk factors contribute to the increased probability of having the disorder.¹⁴ Previous research conducted after other military conflicts (Korean War – 1951, Vietnam War – 1970s) has shown that deployment and exposure to combat result in increased risk of PTSD and increased use of health care services.¹⁵

Given the increased tempo of the fight in the GWOT, recent research studies have provided specific evidence of the prevalence of PTSD among the troops deployed or deploying to Iraq and Afghanistan. These studies can be grouped according to the methodology adopted in research, sampling restrictions, and the time frame of the research. The RAND paper (2008) identified 22 independent studies that have provided specific evidence of the prevalence of PTSD among troops deployed or deploying to Afghanistan and/or Iraq¹⁶ and provided a concise description of these studies via the screening tools and criteria.

The prevailing studies have adopted similar screening tools and criteria for the assessment of PTSD incidence amongst deploying active duty personnel.

¹⁴ William E. Schlenger et al. (1999). *Combat-Related Posttraumatic Stress Disorder: Prevalence, Risk Factors and Co-morbidity*. In Philip A. Saigh & J. Douglas Bremner (Eds.), *Post-traumatic Stress Disorder: A Comprehensive Text* (pp. 69-91). MA: Allyn & Bacon.

¹⁵ C.Hoge, J. Auchterlonie, & C. Milliken, (2006). Military mental health problems: Use of mental health services, and attrition from military services after returning from deployment to Iraq or Afghanistan. *Journal of the American Medical Association*, 295(9), 1023-1032.

¹⁶ Rajeev Ramchand, Benjamin R. Karney, Karen Chan Osilla, Rachel M. Burns and Leah Barnes Caldarone (2008). Prevalence of PTSD, Depression, and TBI among Returning Service members. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 35-84). RAND Corporation.

Most of the prevailing studies, for instance, Hoge et al. (2004)¹⁷, Vasterling et al. (2006)¹⁸ and Grieger (2006)¹⁹ adopted the survey research approach for the analysis of PTSD prevalence among Army active duty personnel. These studies gathered survey responses from convenience samples of Army soldiers who were deployed in either Iraq or Afghanistan from 2003 to 2005. To assess PTSD-related conditions, the studies used as the main screening tool the PTSD Checklist (PCL), which contains 17 questions corresponding to the three clusters of DSM-IV symptoms (American Psychiatric Association, 2000). These symptoms are re-experiencing the event; avoiding stimuli related to the event; and hyperarousal, which is defined as increased arousal, such as difficulty falling or staying asleep. The respondents were to rate the degree they were affected by these symptoms over the past 30 days, and the PCL-DSM-50²⁰ was the common metric for evaluating PTSD occurrences amongst the soldiers.

Another commonality amongst the current literature is the selection of data samples used for the analysis of the prevalence of PTSD. Predominantly, the data are comprised of convenience samples of Army soldiers who were deployed and/or recently returned from Iraq and/or Afghanistan from 2003 to 2005. This is hardly surprising, given that through the current operational profile and mission, the Army soldiers formed a significant portion of the overall deployed troops in Iraq and Afghanistan and thus had a greater probability of being exposed to PTSD.

¹⁷C.W., Hoge C.A. Castro, S. C. Messer, D.McGurk, D.I. Cotting, and R.L. Koffman (2004). Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care. *New England Journal of Medicine*, 351(1),13-22.

¹⁸J. J., Vasterling, S.P. Procter, P.Amoroso, R.Kane, T. Heeren, R. F. White (2006). Neuropsychological Outcomes of Army personnel deployment to the Iraq War. *Journal of the American Medical Association*, 296(5), 519-529.

¹⁹T.A., Grieger, S.J, Cozza, R.J., Ursano, C., Hoge, P.E., Martinez, C.C., Engel, & H.J. Wain, (2006). Posttraumatic stress disorder and depression in battle-injured soldiers. *American Journal of Psychiatry*, 163, 1777-1783.

²⁰ PCL-DSM-50 refers to PCL-DSM + total score of at least 50 (range: 17–85) on PTSD Checklist.

In order to understand and interpret post-deployment mental health and cognitive conditions, several studies conducted surveys across the time span from pre-deployment to in-theater and post-deployment periods for the estimation of prevalence of PTSD amongst military personnel. Hoge et al. (2004) assessed 2,530 Army soldiers one week before their deployment and reported that nine percent screened positive for PTSD using the symptom cluster method and 11 percent screened positive for depression regardless of functional impairment.²¹ Vasterling et al. (2006) found that approximately 75 days prior to deployment; the mean score on the PCL was 29, which is significantly lower than the cutoff value recommended to classify individuals as having PTSD. This study did not present the percentage who met criteria for probable PTSD or depression.²² Other studies (Hoge et al., 2006; Hoge et al., 2007) that focused on post-deployment PTSD occurrences amongst returning soldiers from Iraq and Afghanistan summarized the presence of a high prevalence of PTSD (12 to 13%) during the first three to four months after their return home,²³ with the post-deployment prevalence among Army soldiers being a high of 18%.²⁴ Given the sensitivity of the outcome (being diagnosed with PTSD), it is evident that the surveys gathered from returning military personnel and/or deployed personnel remained the only research approach toward the evaluation of PTSD prevalence in the GWOT.

In sum, the existing research generally has attempted to compare and contrast the mental and cognitive conditions during pre- and post-deployments in order to derive the impact of deployment intensity in Iraq and/or Afghanistan on

²¹C.W., Hoge, C.A. Castro, S.C. Messer, D.McGurk, D.I. Cotting, and R.L. Koffman (2004). Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care. *New England Journal of Medicine*, 351(1),13-22.

²²J. J., Vasterling, S.P. Procter, P.Amoroso, R.Kane, T. Heeren, R. F. White (2006). Neuropsychological outcomes of Army personnel deployment to the Iraq War. *Journal of the American Medical Association*, 296(5), 519-529.

²³C. W., Hoge, A. Terhakopian, C. A. Castro, S. C. Messer, and C. C. Engel. (2007). Association of posttraumatic stress disorder with somatic symptoms, health care visits, and absenteeism among Iraq war veterans. *American Journal of Psychiatry*, 164 (1), 150–153.

²⁴C.W, Hoge, C.A. Castro, S.C. Messer, D.McGurk, D.I. Cotting, and R.L. Koffman (2004). (2004).Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care. *New England Journal of Medicine*, 351(1), 13-22.

the incidence of PTSD amongst deployed active personnel. The target samples have been the large numbers of Army and Marine Corps military personnel who were deployed in Iraq and/or Afghanistan between the years of 2003 and 2005. Most of the studies have established the fact that deployment intensity increased the probability of PTSD amongst active duty personnel who were deployed in Iraq and/or Afghanistan.

D. SHORTCOMINGS IN PREVAILING STUDIES

While most of the prevailing studies were able to draw conclusions that the prevalence of PTSD increased over time and the increased incidence of combat exposure by military personnel raised the probability of having PTSD, there are limitations in these studies. One of the main shortcomings of the literature is the weak generalizability (i.e., the prevalence estimates were only specific to the respective samples examined in the various studies).²⁵ Since the samples that were used in the various studies were not entirely the same, it is difficult to compare the results broadly as there may be unobserved characteristics within each distinct group that may have caused a shift in the PTSD prevalence estimates. As Army soldiers make up the largest portion of the troops in Iraq and Afghanistan, they are the most frequently studied with respect to PTSD (Hoge et al., 2007; Grieger et al., 2006; Vasterling et al., 2006). In order for the studies to encompass and measure the differences in outcomes across all relevant groups, including the deployed personnel from the U.S. Navy and Air Force, the data samples should be randomized and include deployed personnel from these other two services.

Given that the common methodology of assessment of PTSD has been through surveys, there is a tendency for the responses to be “inaccurate”

²⁵ Rajeev Ramchand, Benjamin R. Karney, Karen Chan Osilla, Rachel M. Burns and Leah Barnes Caldarone (2008). Prevalence of PTSD, Depression, and TBI among Returning Service members. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 35-84). RAND Corporation.

predictors for PTSD prevalence in view of respondents' unwillingness to divulge personal information. Since most of the existing literature has adopted the survey research method in consolidating data information, the extent of validity and relevance of these responses from the selected interviewees remains questionable. On top of this, most studies were conducted under the ambit of the DoD, which may have lead to the possibility of respondents under-reporting their problems in order to avoid jeopardizing their careers or over-reporting in order to maintain their disability or medical benefits.

Another area of limitations of current studies lies in the screening tools used to measure the mental and cognitive conditions of PTSD amongst returning soldiers from deployment. Screening tools (PCL-DSM IV) are typically short and simple to administer, but they are not tantamount to diagnostic procedures.²⁶ Moreover, such screening tools are not validated and thus could potentially miss a significant number of those personnel with mental and cognitive conditions. This could produce results that underestimate the actual prevalence of these conditions.²⁷

E. TRENDS OF PTSD TREATMENT COSTS

In view of the rising trends of active duty personnel suffering from PTSD, the main outcomes which are of concern include treatment costs, the costs of lives lost to suicide, and costs related to lost productivity (including reduced employment and lower earnings). Prior studies have projected costs associated with the wars in Afghanistan and Iraq, with medical care as one of the components, and these costs associated with mental and cognitive conditions stemming from the conflicts in Iraq and Afghanistan are substantial. On a per case basis, two-year post-deployment costs associated with PTSD are

²⁶ Rajeev Ramchand, Benjamin R. Karney, Karen Chan Osilla, Rachel M. Burns and Leah Barnes Caldarone (2008). Prevalence of PTSD, Depression, and TBI among Returning Service members. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 35-84). RAND Corporation.

²⁷ Ibid., p. 56.

approximately \$5,904 and \$10,298 respectively and two-year post-deployment costs associated with comorbid PTSD and major depression are \$12,427 to \$16,884 (at 2007 price levels).²⁸ In the 2007 Congressional Budget Office (CBO) testimony before the House of Representatives Committee on Veterans' Affairs, the CBO developed projections of the Department of Veterans Affairs (VA)'s costs to treat all veterans of OIF and OEF who are eligible for VA care. The projections showed that the costs of medical care for veterans of OIF and OEF will grow at the same rate as national health expenditures, and will rise to the range of \$7 billion to \$9 billion by 2017.²⁹

Besides the economic perspective to the analysis of costs of PTSD, there exists the societal perspective as well as the government perspective. The RAND paper (2008) focused on the societal impact—loss in future productivity from PTSD-related disability—and attempted to illustrate and predict the increasing costs of PTSD via a micro simulation model that captures uncertainty that exists in event probabilities and outcomes.³⁰ This study provided comparisons between analyzing the costs from treatment expenditures, lost productivity, and costs associated with suicide. The increasing trends in the treatment costs of PTSD are in tandem with the rising trends of PTSD occurrences amongst the returning active duty personnel as OIF and OEF continue.

The prevailing research has focused on the different aspects of costs related to PTSD and the projections of future costs of PTSD among returning active duty personnel from deployments in Iraq and Afghanistan. As the

²⁸ Christine Eibner, Jeanne S. Ringel, Beau Kilmer, Rosalie Liccardo Pacula and Claudia DiazTerri (2008). The Cost of Post-Deployment Mental Health and Cognitive Conditions. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 169-241). RAND Corporation.

²⁹ Congressional Budget Office (2007). *Projecting the Costs to Care for Veterans of U.S. Military Operations in Iraq and Afghanistan*. Washington D.C.

³⁰ Christine Eibner, Jeanne S. Ringel, Beau Kilmer, Rosalie Liccardo Pacula, and Claudia DiazTerri. The Cost of Post-Deployment Mental Health and Cognitive Conditions. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 169-241). RAND Corporation..

operational tempo in the two regions remains high, the increasing costs for treatment and other forms of follow-on medical care for military veterans will be of utmost concern to the DoD. Current literature may not have the details of the different treatments of PTSD across the different branches of services in the U.S. military. This area of research may enhance the overall understanding of the different clinical approaches toward the treatment of PTSD within the different services and may assist the DoD in the budgetary planning of medical provisions to victims of PTSD.

F. SUMMARY

The prevailing studies in this literature review provide significant advances in the understanding of PTSD among military personnel upon the completion of their combat tours in Iraq and Afghanistan. The sustained duration of OIF and OEF seem to have exacerbated the toll on the deployed soldiers of the U.S. military as the statistics for PTSD continue to climb. In view of the shortcomings of the existing studies on PTSD, this thesis will be analyzing the prevalence of PTSD (taking into account the demographic characteristics) across the different branches of services in the U.S. military from FY2001 to FY2006, by using the medical information from the TRICARE database. This study will also be evaluating the impact of deployment intensity (deployment tour lengths and location) on the probability of PTSD among deployed active duty personnel. To facilitate a more comprehensive understanding of the treatment methods of PTSD across the different branches of services, the potential differences in the treatment costs and patterns for PTSD amongst the diagnosed personnel will be identified in this study based on the clinical data gathered from TRICARE. The specific data samples and the data sources will be discussed in conjunction with the basic assumptions in the next chapter, followed by the methodology to be used in the analysis.

THIS PAGE INTENTIONALLY LEFT BLANK

III. DATA SOURCES AND SAMPLES

A. INTRODUCTION

This chapter provides an overview of the data and their sources. We also discuss the sampling criteria and present the summary statistics based on demographics and frequency distributions of the variables.

B. DATA SOURCES

The data for this thesis came from both TRICARE and DMDC (Defense Manpower Data Center). There were a total of 6 data sets pertaining to all active duty service personnel in the U.S military to be used for the purpose of this thesis, with five data sets from TRICARE and one data set from DMDC between FY2001 to FY2006.

The primary mission of TRICARE, the Department of Defense's (DoD) health care system, is to provide care for eligible active duty personnel, retirees, and dependents. These beneficiaries, currently numbering more than 8.7 million, can receive their care through military hospitals and clinics called military treatment facilities (MTFs) or through TRICARE's civilian provider network. The civilian provider network is developed by managed care support contractors and is designed to complement the availability of care offered by MTFs.

From TRICARE, the data comprised of the main Defense Enrollment Eligibility Reporting System (DEERS) data which provided the basic demographic information as well as the identification of the PTSD diagnosis of the active duty service personnel. The data files of the Standard Inpatient Data Record (SIDR) and the TRICARE Encounter Data – Institutional (TEDI) captured all treatment patterns among the PTSD population for those who were admitted under the inpatient setting while the Standard Ambulatory Data Record (SADR) and TRICARE Encounter Data – Non-Institutional (TEDN) were the data files

which captured the treatment patterns among the PTSD population for those who were admitted to outpatient setting. From DMDC's Contingency Tracking System (CTS), the data file contained information capturing the deployment characteristics of all active duty service personnel from the U.S. military between the FY2001 to FY2006.

1. DEERS Data Set

Eligibility for TRICARE is determined by the DEERS, a database of uniformed services active duty service members (sponsors), family members, and others worldwide who are entitled under the law to TRICARE benefits. Active duty and retired service members are automatically registered in DEERS. The DEERS data contained service-related eligibility and demographic data used to determine eligibility for military benefits, including health care, commissary, and exchange privileges for all service members, retirees, and their family members.

The DEERS data set from TRICARE consisted of the general information of the enrolment across the different branches of the U.S armed services, i.e. one record per active duty or guard/reserve on active duty per month, for each month the member was eligible between FY2001 and FY2006. The EDIPN (Electronic Data Interchange Person Numbers -personnel unique identifier) in the DEERS data set served as the key link across all the other data files which would be used in the study. The entire data set comprised of 3,369,789 unique EDIPN observations of active duty service personnel from all four services (Army, Marine Corp, Navy and Air Force) and their respective demographic information (gender, race, age, military rank/paygrade, service status etc). The detailed composition for the key variables of the DEERS data set from TRICARE, comprising of both PTSD and non-PTSD population, is as shown in Table 3.1.

	PTSD Population	PTSD (%)	Non-PTSD Population	Non-PTSD (%)
Sample				
Number of observations	36,355	1.1	3,333,434	99.0
Sex				
Female	9,477	26.1	533,682	16.0
Male	26,877	73.9	2,799,751	84.0
Marital Status				
Single	15,614	43.0	1,819,054	54.6
Married	20,740	57.1	1,514,379	45.4
Service Branch				
Army	22,263	61.2	1,538,046	46.1
Air Force	4,195	11.5	712,688	21.4
Marine Corps	4,526	12.5	409,012	12.3
Navy	5,369	14.8	673,687	20.2
Rank Status				
Officer and Warrant Officer	2,148	5.9	420,346	12.6
Enlisted Personnel	3,4206	94.1	2,913,087	87.4
Race				
White	24,732	68.0	2,274,402	68.2
Black	6,165	17.0	591,351	17.7
Hispanic	2,254	6.2	178,005	5.3
Asian	930	2.6	120,003	3.6
Others	2,272	6.3	170,005	5.1

Table 3.1. Descriptive Statistics of DEERS Data Set Variables

Within this data set, a total of 36,355 active duty service personnel (based on EDIPN) were identified with PTSD diagnosis between FY2001 and FY2006. Given the identification of the PTSD observations among the military personnel in this data set provided the platform for the cumulative trend analysis of the PTSD incidence rate across the different branches of the armed services in the U.S military. The study would be utilising the DEERS data set to analyze and identify the trends of PTSD incidence across the different branches of armed

services in the next chapter. The DEERS data set with the unique EDIPN information of the active duty service personnel would be the fundamental clinical data file used to merge all the subsequent inpatient and outpatient records via the data sets (SADR, SIDR, TEDI and TEDN) for the purpose of the analysis.

2. Inpatient Records of PTSD Population

A TRICARE beneficiary can utilize the health care services in military treatment facilities³¹ (MTFs) of the Army, Navy, and Air Force, or from civilian health care professionals. The medical records from these two healthcare settings could be further separated into inpatient and outpatient records of the TRICARE beneficiaries. As defined in the TRICARE Operations Manual³², the inpatient care refers to care provided to a patient who has been admitted to a hospital or other authorized institution for bed occupancy for purposes of receiving necessary medical care, with the reasonable expectation that the patient will remain in the institution at least 24 hours, and with the registration and assignment of an inpatient number or designation. Under the DoD's Military Health System (MHS), the SIDR database captures the records of active duty service personnel (enrolled under TRICARE) who sought inpatient care from MTFs, while the TEDI database captures the detailed information of each treatment encounter created by the formal acceptance of a hospital or other authorized institutional provider of a TRICARE beneficiary for the purpose of inpatient care for at least 24 hours with a registration and assignment of an inpatient number or designation.

³¹ MTFs refer to military hospitals or clinics.

³² TRICARE OPERATIONS MANUAL 6010.51-M, AUGUST 1, 2002, Appendix A, p. 21.

a. Standard Inpatient Data Record (SIDR)

The SIDR data is one of the direct care data (inpatient claims) records³³ maintained by TRICARE for the tracking of all inpatient admissions per MTF disposition. The SIDR data are extracted from the Composite Health Care System (CHCS)³⁴ database. The SIDR data file from TRICARE for the purpose of this study contained a total of 373,250 observations (denoted by EDIPNs of active duty service personnel), one record per discharge from a MTF between FY2001 and FY2006 for all active duty military personnel enrolled under TRICARE.

The SIDR data (a monthly updated data base) included details of the ICD-9 CM (International Classification of Diseases, 9th Edition, Clinical Modification) diagnosis codes (denoted by “dx 1-20” in the data set with dx1 being the principle diagnosis), procedural codes (denoted by “proc 1-20” in the data set), source of admission, admission and discharge dates, full cost of treatment, on top of the personal information of the marital status, beneficiary category and the rank/paygrade of all active duty service personnel.

The SIDR data set also provided the important information on active duty service personnel whom have sought treatment at MTF after being diagnosed with PTSD (denoted by ICD-9 CM diagnosis code as “30981”) during FY2001 to FY2006. According to the SIDR data, the total number of PTSD treatment encounters at MTFs was 19,879 during these six years. These records included not only the diagnosis of PTSD (diagnosis code “30981”) but also related co-morbidity influences of alcohol abuse, substance abuse, hypertension etc. With the increased tempo of GWOT post 9/11 incident, the SIDR data set showed an increasing trend of the number of PTSD related inpatient

³³ The other direct care records in TRICARE are the Standard Ambulatory Data Record (SADR - one record per MTF ambulatory encounter or inpatient professional service) and Lab/Rad Ancillary (one record per lab test or per radiology exam).

³⁴ Composite Health Care System (CHCS) database used by military training facilities. CHCS stores patient data including demographics, medical procedures, tests and pharmaceutical information.

treatments received at MTFs by active duty service personnel.³⁵ The details of this are as shown in Table 3.2 below.

FY	Frequency	Percent	Cumulative
2001	2,078	10.5	10.5
2002	2,265	11.4	21.9
2003	2,776	14.0	35.8
2004	4,130	20.8	56.6
2005	4,671	23.5	80.1
2006	3,959	19.9	100.0
Total	19,879	100.0	100.0

Table 3.2. Details of Frequency of PTSD Treatment at the MTFs

For FY2001 to FY2005, there seemed to be an increasing trend (about 56%³⁶) in the number of inpatient admissions to MTFs pertaining to PTSD related diagnosis.

b. TRICARE Encounter Data – Institutional (TEDI)

TRICARE Encounter Data (TED) Records provide detailed information for each treatment encounter and are required for TRICARE Management Activity (TMA) healthcare and financial reporting. Institutional TED (TEDI) records usually reflect a treatment encounter created by the formal acceptance of a hospital or other authorized institutional provider of a TRICARE beneficiary for the purpose of occupying a bed with the reasonable expectation that the patient will remain on inpatient status at least 24 hours with a registration and assignment of an inpatient number or designation. This include the various diagnosis and procedural codes of each treatment encounter, the cost of treatment, the amount allowable for claims through TRICARE plans, the start and end date of care at the civilian hospitals/medical institutions, source of admissions and detailed personal information of the TRICARE enrollees. To

³⁵ The numbers here reflected both new cases of PTSD diagnosis as well as repeated observations of the same active duty personnel (identified by EDIPN) whom were given inpatient care at MTFs during FY2001 and FY2006.

³⁶ Taking the difference between the number of inpatient admissions in FY2005 and FY2001 and divided by 4,671 occurrences in FY2005, the increase from 2001 to 2005 is about 56%.

qualify for claim, any request for payment for services rendered related to care and treatment of a disease or injury which is received from a beneficiary, a beneficiary's representative, or a network or non-network provider by a contractor on any TRICARE-approved claim form or approved electronic medium.

Under the TEDI data set provided by TRICARE, there are a total of 184,057 EDIPN observations of claim put forth by active duty service personnel between FY2001 and FY2006. There are a total of 10,662 cases of PTSD related claims advocated by the active duty service personnel within this span of 6 years. The summary of the number of TEDI claims are as shown in Table 3.3.

FY	Frequency	Percent	Cumulative
2001	1,043	9.8	9.8
2002	1,160	10.9	20.7
2003	1,410	13.2	33.9
2004	1,867	17.5	51.4
2005	2,472	23.2	74.6
2006	2,710	25.4	100.0
Total	10,662	100.0	100.0

Table 3.3. Number of Institutional TRICARE Claims (TEDI) for PTSD Diagnosed Personnel between FY2001 and FY2006

There seemed to be an increase in the number of institutional TRICARE claims for PTSD related treatments between FY2001 and FY2006 from 1,043 to 2,710 (about 62%).

3. OUTPATIENT MEDICAL RECORDS OF PTSD POPULATION

Under TRICARE, all eligible active duty service personnel are also entitled to receive professional/specialized medical services or outpatient care from MTFs or civilian hospitals and institutions. Outpatient observation stays are those services furnished by a hospital on a hospital's premises, including the use of a bed and periodic monitoring by a hospital's nursing or other staff, which are reasonable and necessary to evaluate an outpatient's condition or determine the need for a possible admission to the hospital as an inpatient. Such services are provided when ordered by a physician or another individual authorized by State

licensure law and hospital staff bylaws to admit patients to the hospital or to order outpatient tests. The Ambulatory Data System (ADS) contains records of ambulatory care encounters (SADR) at the MTFs, which are recorded and scanned into the system by each clinic within an MTF. This system operates completely separately from the CHCS system (which captures the inpatient admission records at MTFs).

a. Standard Ambulatory Data Record (SADR)

In 1997, the U.S. Department of Defense (DoD) instituted the SADR to record demographic and diagnostic data on all military outpatient visits, including (ICD-9) codes for each visit.³⁷ The SADR is yet another direct care data files which records per ambulatory encounter, telephone consultation or inpatient rounds visit provided by a MTF for enrollees of TRICARE. This data set basically captures the professional services via outpatient treatments rendered by MTFs. Each record represents the most recent version of hospital record for a patient discharged from an MTF and includes the various diagnosis and procedural codes of each ambulatory encounter, the cost of treatment and detailed personal information.

In the given SADR data set, there are a total of 83,647,524 counts of EDIPNs of active duty service personnel being given outpatient medical services at MTFs. Out of these, there are a total of 2,699,602 observations/records of active duty service personnel being rendered PTSD related outpatient and professional services by MTFs. Based on the SADR records, the breakdown of the number of professional services /outpatient treatments related to PTSD are as follows:

Fiscal year of encounters	Frequency	Percent	Cumulative
--	------------------	----------------	-------------------

³⁷ Paul D. Rockswold, MD, MPH, MHS Medical Informatics Overview 2008 (16 Mar 08). <http://www-nehc.med.navy.mil/presentations08/disease%20mangement/Medical%20informatics/080316-NMCPHC-%20Rockswold%20-MHS%20Medical%20Informatics%202008.ppt>. (assessed on 18 Oct 08)

2001	290,739	10.8	10.8
2002	323,957	12.0	22.8
2003	366,397	13.6	36.3
2004	504,171	18.7	55.0
2005	607,335	22.5	77.5
2006	607,003	22.5	100.0
Total	2,699,602	100.0	100.0

Table 3.4. Number of Professional Services/Outpatient Treatment for PTSD Diagnosed Personnel between FY2001 and FY2006

From the table, there was a significant increase in the number of PTSD related professional services/outpatient care at MTFs rendered to the active duty service personnel over the six years from 290,739 in FY2001 to 607,003 in FY2006 (about 52% increase).

b. TRICARE Encounter Data – Non-Institutional (TEDN)

MTF patients may require medical care that is not available at the MTF (e.g., MRI). When the MTF refers a patient for civilian medical care (usually a specific test, procedure or consultation), including services rendered by an internal resource sharing provider, claims for this type of care will usually be submitted by the provider; however, the patient or the Services (e.g., the MTF) may submit the claim depending on the particular situation.

A non-institutional TED record (TEDN) reflects either inpatient or outpatient health care services exclusive of inpatient institutional facility services. All other treatment encounter data including institutional care in connection with ambulatory surgery must be reported on a non-institutional TED Record. The data set included not only similar medical and personal information as of TEDI (institutional claims) records, but also comprised of total pharmacy costs and the allowable pharmacy bill claimable from TRICARE. The data set has a total of 29,472,160 records and out of which 1,130,720 counts of EDIPN observations were denoted as PTSD related claims between the FY2001 and FY2006. The detailed breakdown of the non-institutional claims is as follows:

FY	Frequency	Percent	Cumulative
2001	71,590	6.4	6.4
2002	97,874	8.8	15.2
2003	126,821	11.3	26.5
2004	184,702	16.5	43.0
2005	292,806	26.2	69.2
2006	344,927	30.8	100.0
Total	1,118,720	100.0	100.0

Table 3.5. Number of Non-Institutional TRICARE Claims (TEDN) for PTSD Diagnosed Personnel between FY2001 and FY2006

There was a significant increase of 79% (273,337 counts) of non-institutional claims between FY2001 and FY2006 by active duty service personnel who have been diagnosed with PTSD.

4. DEPLOYMENT DATA FROM CONTINGENCY TRACKING SYSTEM (CTS) FROM DMDC

As one focus of this study is on the impact of deployment characteristics (i.e. location, deployment duration and frequency of deployment) on the incidence of PTSD among the active duty service personnel between FY2001 and 2006, the deployment data from the CTS system of DMDC is essential for this analysis. This deployment data of 390,921 active duty service personnel (which were the non-PTSD population denoted by unique EDIPNs) from Defense Manpower Data Centre's (DMDC) Contingency Tracking System (CTS), only depicted 10% of all active duty personnel (a randomly selected sample) who have been deployed for GWOT, in view of the confidentiality of deployment characteristics and personnel profiles vis-à-vis the GWOT environment and mission requirements. Of the overall deployed population, there are a total of 24,826 EDIPN observations of personnel whom have been diagnosed with PTSD between FY2001 and FY2006. A summary of the total number of observations in the CTS deployment data is shown in Table 3.6 below:

Data Groups	Number of Non-PTSD Observations	Number of PTSD Observations
Army	284,437	22,050
Navy	34,978	5,472
Marine Corps	37,558	4,575
Air Force	23,622	4,118
Total	380,595	35,715

Table 3.6. Summary of Observations in the CTS Deployment Data for FY2001 to FY2006

The dataset included the deployment details (i.e. deployment location, deployment duration, number of deployments etc) of all the active duty service personnel from the different branches between the FY2001 to FY2006.

The dataset consist of a total of 24 deployment profiles of each active duty service personnel during the period of FY2001 to FY2006. Out of the four services, there were a total of 38,985 EDIPN observations of active duty service personnel whom were diagnosed with PTSD in the same period. This data represented the 100% PTSD population from all the active duty service personnel whom were deployed overseas between FY2001 and FY2006. As EDIPN is the common personal unique identifier across the DEERS and CTS data sets, these two data sets would be merged for the analysis on the impact of deployment characteristics on the prevalence of PTSD among active duty service personnel in GWOT from FY2001 to FY2006. The detailed analysis would be covered under Chapter VI of the study.

C. DATA SAMPLES

For the analysis of research question 1, the DEERS data set from TRICARE has been reorganized into the four separate branches of the armed services, namely, Army, Marine Corp, Navy and Air Force between FY2001 and FY2006. As EDIPN is the key unique personnel identifier across all the data

sets used in this study, all missing values of EDIPN in the DEERS data set were dropped from the analytical sample. These data would be sub-divided into the two distinct populations of non-PTSD and PTSD³⁸ observations with the relevant demographic variables (i.e. gender, race, ethnicity, marital status, and military rank/paygrade) and fiscal year dummies from FY2001 to FY2006. All missing or unknown values for the demographic variables were dropped as well since no further information could be derived. To analyze the potential differences between the officer and enlisted populations in the PTSD incidences, the four services' DEERS data files were further sub-divided into these two categories respectively³⁹.

The CTS deployment data set from DMDC is organized into five separate files, comprising of the deployment information (demographics, military rank/paygrade, deployment locations, duration of deployment, military operational specialty (MOS) etc) of the active duty service personnel from the different branches of services and the consolidated data information pertaining to all active duty service personnel whom were diagnosed with PTSD during the period of FY2001 to FY2006. In view of the sensitivity of the detailed deployment information on the military personnel, DMDC only provided 20% of the entire non-PTSD population (via random sampling) whom were deployed during FY2001 to FY2006. In other words, the entire CTS deployment data which would be used for the analysis of the deployment effects on PTSD occurrences is actually a weighted sample of the overall non-PTSD deployed population across the four military services.

³⁸ The PTSD observations in all the data sets were denoted as "T" under the variable "ptsdflag".

³⁹ The Warrant Officers within the Army, Marine and Navy were grouped under the "Officers" category.

For the inpatient and outpatient data files of SIDR, TEDI, SADR and TEDN, this information would be merged with the CTS data via EDIPN so as to derive the patterns of PTSD treatment across the different branches of service. The study would concentrate on the PTSD related cases denoted in these data sets to assess the comorbidity risks and treatment costs of PTSD and determine if there were different patterns to comorbidity distribution and treatment across the different branches between FY2001 and FY2006. All missing values of the EDIPN would be dropped since the information would be meaningless without an unique personnel identifier.

D. DATA RESTRICTIONS

The DEERS data set would be used to identify the PTSD prevalence across the different branches of armed services in the U.S military between FY2001 and FY2006. There are basically two restrictions derived from the data sets obtained from TRICARE and DMDC. Given the large DEERS data sets of the different branches of services in the U.S military, the study could have been more precise from the clinical perspective, if not for the fact that there were many observations without the information on EDIPN. Without these unique identifiers for personnel, it was impossible to pursue the analysis further as the different data sets could not be merged to derive results. Thus, all observations in the DEERS data with missing EDIPN have to be omitted from the study, resulting in much bigger standard errors in the distribution, though still significant data sample for the purpose of this study. In addition, a large number of the DEERS observations with missing demographics information (gender, marital status, race or ethnicity) and military rank/paygrade were dropped as well.

The second restriction is one that is imposed by DMDC on the complete release of the overall deployment details from FY2001 to FY2006 across the different branches of services in the U.S military. In view of the confidentiality of deployment profiles of the military personnel, different operational environment and mission requirements in GWOT, DMDC only released the data of 20%

random sample of the non-PTSD population on top of the PTSD population between the years of FY2001 and FY2006. As such, the study would be based solely on the weighted sample of the non-PTSD and the PTSD population for the analysis of the deployment effects on PTSD occurrences amongst the active duty personnel from the different branches of services in the U.S. military.

E. SUMMARY

This chapter provides an overview of the 6 data sets, namely the DEERS data set, the data sets of SIDR, SADR, TEDI and TEDN and the CTS Deployment Data as gathered from TRICARE and DMDC. These data sets provide both the clinical information as well as the deployment characteristic of the PTSD diagnosed cases amongst the active duty service personnel between the FY2001 and FY2006 for the analysis of PTSD prevalence, the deployment effects on PTSD incidences and the comorbidity risks among the active duty service personnel across the four main armed services of the U.S military.

However, there is a need to note the two data restrictions and its possible impact on this study. The omission of large numbers of missing EDIPN (from the DEERS data set) from the sample used for the study may affect the precision of the analysis given the large standard errors present in the frequency distribution of the data. In addition, the restriction on the availability of the deployment data by DMDC that could be used to formulate the overall model for the analysis of deployment effects on PTSD incidences among the active duty service personnel may render a less precise outcome of the multivariate analysis on the impact of deployment characteristics on PTSD occurrences among the deployed troops.

The next chapter would be the discussion on the methodology with a detailed breakdown of the regression models which would be used for this study, followed by the subsequent chapters that would focus on the respective research questions with in-depth analysis.

IV. ANALYTICAL METHODOLOGY

A. INTRODUCTION

This chapter will describe the hypotheses and the analytical methodology used to examine the three research questions outlined in the introduction. The three research questions are:

- What is the probability of being diagnosed with PTSD across different branches of the U.S. military and how is this affected by different demographic characteristics?
- How do risk factors including deployment intensity (such as deployment location, tour length and frequency of deployment) affect the probability of being diagnosed with PTSD, and do these effects differ across the branches?
- What are the comorbidity risks and treatment costs of PTSD, and are there different patterns to comorbidity distribution and treatment across the different branches?

The rest of this chapter will be organized as follows: Section B will lay out the research hypotheses for the research questions. Sections C, D and E will describe the empirical methods used to analyze each research question. Section F will provide a summary.

B. RESEARCH HYPOTHESES

One of the main objectives of the thesis is to examine the effect of deployment intensity (such as deployment location, duration and location type of deployment) on the probability of being diagnosed with PTSD across the different branches of the U.S. military. Most of the prevailing studies have focused on Army active duty personnel deployed to Iraq and/or Afghanistan, and established

that the increasing deployment intensity in the GWOT have raised the probability of PTSD amongst these personnel. We hypothesize that as the number and duration of deployments to Iraq and/or Afghanistan increases, the probability of being diagnosed with PTSD will also increase for personnel from other branches of the armed services.

We also hypothesize that the effect of deployment intensity (deployment location, duration and frequency) on the probability of being diagnosed with PTSD will be greater for deployed personnel from the Army and Marine Corps, compared to their counterparts in the Air Force and Navy. Due to their operational profiles and the nature of their deployments, personnel from the Army and Marine Corps are mostly deployed in ground combat operations and more likely to be exposed to the “war-zone trauma” that induces PTSD. Sailors who are deployed on ships, and airmen, on the other hand, are less likely to be exposed to the violent conditions in a “war-zone.” These airmen and sailors typically do not engage in close-range combat as their targets are often beyond visible range in modern aerial and naval warfare. Hence, we postulate that for the same deployment location, a soldier from the Army or the Marine Corps will be more likely to be diagnosed with PTSD compared to a sailor deployed onboard a ship or an airman.

In addition, we postulate that different deployment locations have different effects on the probability of being diagnosed with PTSD. The ongoing military operations in Iraq and Afghanistan represent the most sustained ground combat operations involving American forces since the Vietnam era. Personnel deployed in Iraq and Afghanistan is frequently exposed to high intensity guerilla warfare and the chronic threat of improvised explosive devices (IED). We hypothesize that personnel who have been deployed to Iraq and/or Afghanistan will have a higher probability of having PTSD, compared to personnel deployed elsewhere.

Finally, we hypothesize that the effect of deployment duration on the probability of being diagnosed with PTSD is dependent on the deployment location. Due to the intense threat environment in Iraq and Afghanistan, the effect

of deployment duration on the probability of being diagnosed with PTSD is expected be exacerbated if the deployment location is Iraq or Afghanistan, compared to other countries.

We employ a combination of descriptive and multivariate analyses to examine the effect of different measures of deployment intensity on the probability of being diagnosed with PTSD. Separate analyses are conducted for officers and enlisted personnel. In addition, separate multivariate analyses are performed for the four branches of the U.S. military. The results of these analyses are compared and discussed in the following chapters.

C. PREVALENCE OF PTSD IN THE ACTIVE DUTY U.S. ARMED SERVICES

The first research objective of our thesis is to examine the probability of being diagnosed with PTSD across the four services of active duty U.S. military and the various service and demographic characteristics (rank, gender, marital status, race and age). Descriptive data analyze are used to analyze the data from the Defense Enrollment Eligibility Reporting System (DEERS) provided by TRICARE, to establish the probability of being diagnosed with PTSD across the different service branches and demographic characteristics. The descriptive data provides a summary of the DEERS data and the distribution of the service and demographic characteristics for the PTSD and non-PTSD populations. In addition, it also indicates whether any particular sub-population has a higher probability of being diagnosed with PTSD.

An initial analysis of the DEERS data shows that a higher percentage of personnel from the Army and Marine Corps are diagnosed with PTSD, compared to personnel from the Air Force and Navy. The initial analysis also indicates that enlisted personnel have a higher rate of PTSD than officers in all service branches. These initial findings were expected and agree with results from prevailing studies.

We conduct trend analyses using data from the DEERS and the Defense Manpower Data Centre's (DMDC) Contingency Tracking System (CTS). Trend analyses on the number of new PTSD cases diagnosed and the cumulative PTSD incidence rate between FY2001 to FY2006 across the services are conducted. In this thesis, the cumulative PTSD incidence rate is the percentage of the study population who has been diagnosed with PTSD since FY2001, up to the respective study year. For example, the cumulative PTSD incidence rate for FY2005 will include all PTSD cases diagnosed between FY2001 up to FY2005. Trend analyses are conducted for the following three different populations.

1. All Active Duty TRICARE Beneficiaries

The DEERS data provide the date of the PTSD diagnoses for the PTSD population. The first trend analysis utilizes the DEERS data and analyzes new occurrences of PTSD cases and the cumulative PTSD incidence rate for all enrolled active duty TRICARE beneficiaries across the services. Separate analyses are conducted for the officer and enlisted populations. The result of these analyses allow readers to compare the trend in the number of new PTSD cases diagnosed each year, and the cumulative percentage of all active duty TRICARE beneficiaries who are diagnosed with PTSD across the different services from FY2001 to FY2006.

2. Active Duty TRICARE Beneficiaries Who Were Ever Deployed Overseas

The second trend analysis utilizes both the DEERS and CTS data. The CTS data contains the deployment history (deployment date, location and duration) of all the active duty personnel between FY2001 and FY2006. Due to the sensitivity of the detailed deployment information on the military personnel, the CTS data is only available for the active duty PTSD population, and a 20% random sample of the active duty non-PTSD TRICARE beneficiaries.⁴⁰

⁴⁰ This is the same sample that will be used for the multivariate analysis, i.e. the regression sample will consist of all the active duty TRICARE beneficiaries who are diagnosed with PTSD between FY2001 to FY2006, and a randomly selected 20% sample of non-PTSD beneficiaries.

Probability weights are used in this trend analysis to account for the data restriction and sampling design. The DEERS and CTS data are merged using a unique identifier that is common to both datasets. The merged data contains both the demographics characteristics and deployment histories of the PTSD and non-PTSD populations.

This second analysis considers only the active duty TRICARE beneficiaries who were ever deployed overseas outside the United States, between FY2001 and their date of being diagnosed with PTSD. Beneficiaries who have been diagnosed with PTSD, but have not been deployed overseas between FY2001 and their date of PTSD diagnoses are excluded in this trend analysis. The results of the second analysis, when compared to those of the first analysis, indicate the effect of overseas deployment on the probability of being diagnosed with PTSD across the service branches.

3. Active Duty TRICARE Beneficiaries Who Were Ever Deployed to Iraq and/or Afghanistan

The third trend analysis also utilizes both the DEERS and CTS data. Most of the deployments in the current GWOT, e.g. Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) occur in Afghanistan and/or Iraq. Therefore the third analysis focuses on the active duty TRICARE beneficiaries who were ever deployed to Iraq and/or Afghanistan between FY2001 and their dates of being diagnosed with PTSD. The results of the third analysis show the effect of deployment to Iraq and/or Afghanistan on the probability of being diagnosed with PTSD. This analysis also uses probability weights to account for the data restriction in the CTS data and the sampling design.

D. EFFECT OF DEPLOYMENT INTENSITY ON THE PROBABILITY OF BEING DIAGNOSED WITH PTSD

A combination of descriptive and multivariate analyses is used to examine the effect of deployment intensity on the probability of being diagnosed with

PTSD. Due to data restriction, the sample for the multivariate analyses only consists of the PTSD beneficiaries and a 20% random sample of the non-PTSD beneficiaries. Descriptive analyses are first used to provide a summary of the sample for the multivariate analyses, and their service and demographic characteristics' distribution. The descriptive summary allows us to verify that the regression sample is representative of the DEERS population and validates the sampling design.

The DEERS dataset contains a monthly database of active duty service members who are entitled to TRICARE benefits. Hence a single unique service member (represented by his or her EDIPN) may have had up to 72 monthly observations in the DEERS dataset in the 6-year study period (FY2001 to FY2006) of this thesis. For the multivariate analyses, a single observation is required for each unique service member or EDIPN. For the PTSD population, i.e., those who were diagnosed with PTSD between FY2001 to FY2006, the monthly observation that corresponded to their PTSD diagnosis date is selected for the multivariate analysis. For the non-PTSD population, an observation is randomly selected from their monthly records.

Four multivariate analysis models are used to test the hypotheses and examine the effect of deployment intensity on the probability of being diagnosed with PTSD. For each model, separate analyses are conducted for the four service branches. In addition, separate analyses are carried out for the officer and enlisted populations.

1. Theoretical Model

The dependent variable in the four multivariate models is a binary indicator which captures whether a personnel is diagnosed with PTSD. The dependent variable takes on the value of one if the person is diagnosed with PTSD, and zero otherwise. Due to the dependent variable being dichotomous, the probit model is used to estimate the effect of deployment intensity on the probability of being diagnosed with PTSD. The probit model is preferred over the

Linear Probability Model (LPM) for this thesis. In a LPM, the predicted value of the dependent variable is not constrained within the interval of zero and one, and the marginal effect of any independent variable is constant throughout its entire range of value. The probit model, on the other hand, is non-linear and restricts the predicted value of the dependent variable to between zero and one.

2. Independent Variables

The base model for the multivariate analysis is described below:

$$P(y = 1 | x) = \beta_0 + \beta_1 X_1 + \beta_2 X_2,$$

where X_1 = deployment characteristics

where X_2 = service and demographic characteristics

The vector X_1 contains the key variables of interest for the respective probit model. These key variables are based on the deployment characteristics in the CTS data, namely deployment location and duration and location type of the deployment (ground or shipboard) and are different for each of the four models. The specific variables of interest for the respective probit model are described in a later section of this chapter.

The vector X_2 contains the service and demographic characteristics. These service and demographic characteristics are the control variables and remain the same across the four probit models for each service branch and study population. The service and demographic characteristics are described below.

a. Service Characteristics

(1) **Military Occupation Codes.** The Military Occupation Code is provided in the CTS data. The four service branches use different sets of military occupation codes. The Army and Marine Corps use a Military Occupational Specialty (MOS) code, while a system of Air Force Specialty Codes (AFSC) is used in the Air Force. The Navy uses a system of naval ratings and designators along with the Naval Enlisted Classification (NEC) system. All

observations are categorized into the various military occupation categories using binary variables. The categories are combat arms, combat support, combat service support, aviation, medical and others. The combat arms and medical categories are expected to have the largest effect on the probability on being diagnosed with PTSD. The combat arms are the reference group for the multivariate analyses. For some service branches, some of the categories are merged due to small numbers of observations in the individual categories.

(2) **Pay Grade.** The pay grade information is provided in the DEERS data. The observations are categorized into several pay grade categories using binary variables. The categories are: O1 to O2, O3, O4, O5, O6, O7 to O10 and W1 to W5 for officers, and E1 to E3, E4, E5, E6, and E7 to E9 for enlisted personnel. The reference group is the most junior pay grade category for the respective population. For example, the reference group for the officer population in the Army, Marine Corps and Navy is W1 to W5, while O1 to O2 is the reference group for the Air Force as there are no warrant officers in the Air Force.

b. Demographics Characteristics

(1) **Gender (Male, Female).** The gender information is provided by the DEERS data and encoded by the binary variable FEMALE. It takes on a value of one if the gender is Female, and zero otherwise. Males are the reference group, as the populations are pre-dominantly male.

(2) **Race (White, Black, Hispanic, Asian, Others).** The race and ethnic information found in the DEERS data is transformed into binary variables for the races. Whites are the reference group for the multivariate analyses.

(3) **Marital Status (Single, Married).** The marital status information is included in the DEERS data and is encoded by the binary variable

SINGLE. It takes on a value of one if the marital status is single, and zero, otherwise. Married personnel are the reference group.

(4) **Age.** The CTS data contains the personnel's date of birth. The age variable is a continuous variable and reflects the age of the personnel at the time of observation. Observations with missing age information take on the average value of the non-missing age.

The models also contain binary variables for the fiscal years (FY01, FY02, FY03, FY04, FY05 and FY06, in order to capture changes across the years. The fiscal-year variables indicate the fiscal year of the PSTD diagnosis date for the PTSD population and the date of the DEERS observation for the non-PTSD population respectively. The reference year is FY2001.

3. Model Specification

Four probit models are set up to test the hypotheses and estimate the effect of deployment characteristics on the probability of being diagnosed with PTSD. The service and demographics variables are held constant in all four models. The models and their respective key variables of interest are described below.

a. Effect of Last Deployment Location

The first model estimates the effect of the last deployment location on the probability of being diagnosed with PTSD. For the PTSD population in the regression sample, the last deployment refers to the most recent deployment prior to the date of being diagnosed with PTSD. For the non-PTSD population, the last deployment refers to the most recent deployment prior to the DEERS observation's date. The key variables of interest are the last deployment location and the location type.

(1) **Deployment Location (Iraq, Afghanistan, Other Middle East countries, Other countries).** The deployment locations are found in the CTS data. The location variables are binary variables for being deployed to

Afghanistan, Iraq, Middle East countries other than Iraq and Afghanistan, and other countries. The reference group constitutes of those with no deployment prior to their PTSD diagnosis date for the PTSD population, or the date of observation for the non-PTSD population. Due to the chronic threats experienced by personnel deployed in Afghanistan and Iraq, these two deployment locations are expected to have the largest effect on the probability of being diagnosed with PTSD.

(2) **Deployment Location Type (Shore, Afloat).** This variable is applicable only for observations from the Navy. The CTS data contains information that indicates the location type of the deployment for the sailor. A sailor can be deployed ashore or afloat. Besides the location effect, the model also estimates the effect of the location type of the deployment on the probability of being diagnosed with PTSD. Hence in the analyses for the Navy, the binary location variables incorporate the location type of the deployment. These location variables are: shore deployment in Afghanistan, shore deployment in Iraq, ship deployment in Afghanistan or Iraq, shore deployment in Middle East countries other than Afghanistan or Iraq, ship deployment in Middle East countries other than Afghanistan or Iraq, shore deployment in other countries, and ship deployment in other countries. The reference group is comprised of those without any deployment prior to their PTSD diagnosis date or date of observation. Sailors on shore deployment are expected to be more likely to be diagnosed with PTSD, compared to sailors deployed on ships, as the former are likely to face higher threats.

b. Interactive Effect of Last Deployment Location and Duration

The second model is an expansion of the first model. The second model takes into account the interaction of the location and duration variables of the last deployment, to examine whether the effect of deployment duration on being diagnosed with PTSD is dependent on the deployment location. The last

deployment refers to the most recent deployment prior to the PTSD diagnosis date or date of observation. The key variables of interest for the second models are the last deployment location, its duration and the interaction terms between the last deployment location and duration.

(1) **Deployment Location.** The binary location variables for the second model are identical to the location variables in the first model.

(2) **Deployment Duration (Short, Medium, Long).** The CTS data contains the duration of the deployment. All deployments are categorized, based on their duration, as short, medium or long deployments. These duration categories are represented by binary variables. As the deployment duration differed between the services, the interval definition for short, medium and long deployment was determined by the distribution of the deployment duration for each service in the empirical data. The cutoffs for the intervals for each service are chosen such that each interval contains approximately the same percentage of observations for each service. For example, a 130-day deployment is categorized as a short deployment for the Army and Marine Corps, while a 130-day deployment in the Air Force and Navy is considered a medium deployment. The reference group is those who had not been deployed overseas prior to their PTSD diagnosis date or date of DEERS observation. We expect a long deployment to have a larger effect on the probability of being diagnosed with PTSD, compared to a short deployment. The interval definition for the four service branches is shown in Table 4.1.

	Army	Air Force	Marine Corps	Navy
Short	1 to 180 days	1 to 90 days	1 to 180 days	1 to 120 days
Medium	181 to 270 days	91 to 150 days	181 to 270 days	121 to 180 days
Long	271 days or more	151 days or more	271 days or more	181 days or more

Table 4.1. Deployment Duration Interval Definition for the Services

(3) **Interaction between Deployment Location and Duration.** This set of variables is the set of interaction terms between the last deployment location and its duration. This set of variables captures whether the effect of deployment duration is exacerbated or mitigated by the deployment location. Based on an initial analysis of the sample size for the various deployment locations and duration categories, the model requires only two interaction terms, namely “medium deployment duration in Afghanistan or Iraq” and “long deployment duration in Afghanistan or Iraq.” Due to the chronic threats faced by the personnel in Afghanistan and Iraq, the duration effect is expected to be exacerbated for personnel deployed in these two countries, compared to personnel deployed elsewhere.

c. Effect of Deployment Location History

While the first two models focus on the effect of the last deployment on being diagnosed with PTSD, the third model extends the study to include all the past deployments in the individual’s deployment history in the study period. Specifically the third model considers if a personnel has ever been deployed to the various locations between FY2001 and FY2006, prior to their PTSD diagnosis date or date of observation, and estimates the effect of ever being deployed to these locations on the probability of being diagnosed with PTSD. The key variables of interest are the locations of the past deployments.

(1) **Past Deployment Location.** The binary location variables in the third model are different from the location variables in the first two models. The binary variables in the third model capture whether the person has ever been deployed to the various locations between FY2001 to FY2006, prior to their PTSD diagnosis date or date of observation. Deployments that occurred after the PTSD diagnosis date or date of observation are considered, as these post-diagnosis deployments (if any) do not affect the value of the location variables. For example, the location variable for Afghanistan takes on the value of one if a person had ever been deployed to Afghanistan between FY2001 to

FY2006, and prior to his PTSD diagnosis date or date of observation. The location variable takes on the value of zero if the personnel had never been deployed to Afghanistan between FY2001 to FY2006, or if the deployment to Afghanistan occurred after his PTSD diagnosis date or date of observation. The reference group is made up of the personnel with no past deployments prior to their PTSD diagnosis date or date of observation, within FY2001 to FY2006.

In the multivariate analyses for the Navy, these past deployment location variables also reflect the location type (shore or afloat) of the past deployments, e.g. for a sailor who has been deployed to Afghanistan, the model differentiates and estimates the effect of having ever been deployed ashore in Afghanistan, or deployed onboard a ship in Afghanistan separately.

d. Effect of Single and Multiple Deployments to the Same Location

Repeated deployments to certain locations could have a cumulative and exacerbated effect on the probability of being diagnosed with PTSD. The fourth model expands on the third model by considering all past deployments in a person's deployment history between FY2001 to FY2006, which occurred prior to his PTSD diagnosis date or date of observation, and estimates the effect of single and multiple deployments to the same location on the probability of being diagnosed with PTSD. The key variables of interest are thus two sets of binary location variables.

(1) **Single Deployment to a Location.** The first set of location variables takes on the value of one if the person has been deployed only once to the respective locations within FY2001 to F2006, and prior to his PTSD diagnosis date or date of observation. Deployments that occurred after the PTSD diagnosis date or date of observations (if any) are not considered. The reference group is those personnel who have not been deployed prior to the PTSD diagnosis date or date of observation, within FY2001 to FY2006.

(2) **More than One Deployment to the Same Location.**

This set of location variables takes on the value of one only if the person has been deployed more than once to the respective locations within FY2001 to FY2006, and prior to his PTSD diagnosis date or date of observation. Deployments that occurred after the PTSD diagnosis date or date of observations (if any) are not considered. This set of variables captures whether the effect of the deployment location is exacerbated or mitigated by the number of deployments to the same location. The reference group is those personnel who had not been deployed prior to the PTSD diagnosis date or date of observation, within FY2001 to FY2006.

Besides the two sets of location variables above, the model for the Navy includes two other variables to estimate the effect of a single and multiple shore deployment on the sailors' probability of being diagnosed with PTSD. These two binary variables take on the value of one if the sailor has been deployed only once on a shore deployment, or has been deployed in more than one shore deployment respectively.

E. COMORBIDITY RISKS AND TREATMENT COSTS AMONG THE PTSD POPULATION

The third research objective is to analyze the pattern of comorbidity risks and treatment costs for PTSD across the four service branches. Hence the study population for the third research objective is limited to only the PTSD population, i.e., those who had been diagnosed with PTSD between FY2001 to FY2006. The DEERS data set containing the demographics characteristics of the PTSD population is merged with the TRICARE inpatient and outpatient claim records (SADR, SIDR, TEDI and TEDN) for this analysis. We use descriptive analyses to analyze the pattern of comorbidity risks and treatment costs at two different levels of resolution, namely at the claim and person level. We establish the pattern of comorbidity and treatment cost associated with each claim, as well as for each TRICARE beneficiary diagnosed with PTSD. Separate analyses are

conducted for officers and enlisted personnel. In addition, we analyze whether there is a differential comorbidity distribution or treatment cost between males and females, and between white and non-white population. The results of these analyses are discussed in Chapter VII.

1. Comorbidity Risks

The inpatient and outpatient claim records (SADR, SIDR, TEDI and TEDN) contains the ICD-9 CM (International Classification of Diseases, 9th Edition, Clinical Modification) diagnosis codes for each observation. We focus on the patterns of comorbidity risks for claims whose primary and secondary diagnosis is PTSD (ICD-9 CM code 30981). The common comorbidities associated with PTSD have been identified and categorized into several groups. Descriptive statistics are used to analyze the distribution of these comorbidities across the four services and the demographics characteristics such as gender and race. The comorbidity categories⁴¹ are listed in Table 4.2.

	Category of Comorbidities	ICD-9 CM Codes / Remarks
1.	Major depression	292.2, 296.3
2.	Substance abuse	291 – 292, 303 – 305
3.	Other psychoses	295 – 299, excluding 296.2 and 296.3
4.	Any other mental health problems	290 – 312, excluding 291 - 292, 295 – 299, 303 – 305
5.	Unspecified mental and behavioral problems	V40
6.	Acute illness	Numerical ICD-9 CM codes less than 290 and more than 319, excluding E and V codes.

Table 4.2. Categories of Comorbidities for PTSD

⁴¹ Robert Rosenheck and Alan Fontana. *Use of Mental Health Services by Veterans with PTSD After the Terrorist Attacks of September 11*
<http://ajp.psychiatryonline.org/cgi/content/full/160/9/1684>, accessed 27 Nov 2008

2. Treatment Costs

The inpatient and outpatient claim records also provide valuable information on the treatment costs and duration for PTSD. We compute and analyze how the treatment cost of PTSD at military treatment facilities (MTFs), and civilian hospitals and institutions, differs across the service branches and demographics characteristics. We use data from the inpatient claims records (SIDR and TEDI) to compare the average total inpatient treatment cost at MTFs against the average bill charged and average claim allowed for inpatient health care services rendered by the TRICARE providers. Similarly, we evaluate the patterns in the average total outpatient treatment cost and pharmacy cost at MTFs, versus the patterns in the average bill charged and average claim allowed for outpatient treatment by TRICARE providers, based on data in the outpatient claims records (SADR and TEDN).

In addition, we also analyze the patterns in the treatment duration and usage of MTFs and civilian care facilities across the various study populations.

F. SUMMARY

This chapter describes our methodological approach, as well as the statistical and multivariate analysis models used to analyze the three research objectives of this thesis. A combination of descriptive and multivariate analysis models are used to evaluate the probability of PTSD across the service branches and to examine the effect of deployment intensity on the probability of being diagnosed with PTSD. In addition, descriptive analyses are used to analyze the patterns of comorbidity risks and treatment cost of PTSD. The results of these statistical and multivariate analysis models are discussed in depth in the next three chapters.

V. DESCRIPTIVE RESULTS AND TREND ANALYSIS OF PTSD PREVALENCE: COMPARISON ACROSS BRANCHES

A. OVERVIEW

While most of the prevailing studies have drawn conclusions that the prevalence of PTSD has increased over time and the increased incidence of combat exposure by military personnel has raised the probability of having PTSD, there are limitations in these studies. One of the main shortcomings of the current literature is their weak generalizability (i.e., the prevalence estimates were only specific to the respective samples examined in the various studies).⁴² The current literature is based mostly on data inferences from deployed troops from the Army and Marine Corps. There is little or no information on statistics for the Air Force and the Navy and thus little is known about the prevailing medical health conditions of those active duty service personnel from the Air Force and the Navy who were also deployed in combat zones similar to their Army and Marine Corps counterparts.

This chapter will focus on the assessment of the trends of PTSD across the different service branches from FY2001 to FY2006. Data from the Defense Enrollment Eligibility Reporting System (DEERS) provided by TRICARE and from the Contingency Tracking System (CTS) provided by Defense Manpower Data Centre (DMDC) are used to provide a more comprehensive view into the prevalence of PTSD across the four services (the Army, Air Force, Marine Corps and Navy) of the U.S military. Section B of the chapter provides summary statistics of the samples by PTSD and non-PTSD population. Section C presents

⁴² Rajeev Ramchand, Benjamin R. Karney, Karen Chan Osilla, Rachel M. Burns and Leah Barnes Caldarone (2008). Prevalence of PTSD, Depression, and TBI among Returning Service members. In Terri Tanielian & Lisa H. Jaycox. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 35-84). RAND Corporation.

a detailed trend analysis of PTSD cases during the study period. Section D provides a summary of the findings.

B. SUMMARY STATISTICS OF THE DATA SAMPLES – PTSD AND NON PTSD POPULATION

The entire DEERS data set is composed of 3,390,387 unique EDIPN observations of active duty service personnel from all four services (Army, Marine Corp, Navy and Air Force) and their respective demographic information (gender, race, age, marital status, military rank/paygrade). To facilitate a better understanding of the summary statistics of the data samples of the different service branches, the overall data set is organized into two broad categories of officers and warrant officers, and enlisted personnel respectively. These are further divided into the non-PTSD and PTSD populations in accordance with their respective services.

1. Officers and Warrant Officers Population

The officers and warrant officers data samples consisted of a total of 423,658 observations (12.6% of total observations). The detailed breakdown for the DEERS officers and warrant officers' sample is as shown in Table 5.1.

Officers and Warrant Officers										
	Army		Air Force		Marine Corps		Navy		Total	
	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD
Sample Size	184,917		121,851		29,065		87,871		423,704	
Number of observations	183,603	1,314	121,450	401	28,930	135	87,559	312	421,542	2,162
% of observations / service	99.3%	0.7%	99.7%	0.3%	99.5%	0.5%	99.6%	0.4%	99.5%	0.5%
Sex										
Female	15.5%	27.0%	18.8%	51.1%	6.1%	14.1%	16.0%	42.3%	15.9%	32.9%
Male	84.5%	73.0%	81.2%	48.9%	93.9%	85.9%	84.0%	57.7%	84.1%	67.1%
Marital Status										
Single	31.4%	27.8%	31.3%	36.4%	31.5%	27.4%	40.6%	37.5%	33.3%	30.8%
Married	68.6%	72.2%	68.7%	63.6%	68.5%	72.6%	59.4%	62.5%	66.7%	69.2%
Race										
White	77.3%	72.6%	82.6%	78.3%	82.8%	88.1%	83.1%	80.1%	80.4%	75.7%
Black	11.9%	14.3%	7.1%	9.0%	6.7%	4.4%	7.2%	6.1%	9.2%	11.5%
Hispanic	2.4%	4.0%	1.6%	3.5%	2.6%	3.0%	3.5%	5.8%	2.4%	4.1%
Asian	3.8%	2.5%	2.1%	1.7%	1.6%	0.7%	3.6%	4.5%	3.1%	2.5%
Other races	4.6%	6.5%	6.6%	7.5%	6.3%	3.7%	2.6%	3.5%	4.9%	6.1%
Age										
Mean age (year)	35.9	38.8	34.8	37.5	34.3	36.7	34.5	37.7	35.2	38.3

Table 5.1. Summary Statistics of the DEERS Data Samples of the Four Services (Officers and Warrant Officers)

Table 5.1 shows that less than 1% of the active duty officer population across the four services enrolled in TRICARE was diagnosed with PTSD. The officer sample was comprised predominantly of male service personnel (84%). Males also dominated the non-PTSD population (ranging from 81% to 94%) across all four services. For instance, the non-PTSD population in the Air Force consisted of 81% male and 19% female. However, females have a higher rate of being diagnosed with PTSD (ranging from 14% to 51%) across all four services, particularly in the Air Force and Navy. In the Air Force, females constituted only 19% of the non-PTSD population, but they constituted 51% of the PTSD population. Similarly, females constituted a disproportionately higher percentage of the PTSD population (42%), compared to the PTSD population (16%) in the Navy.

Table 5.1 indicates that there was a higher percentage of married officers (except for the Air Force) among the PTSD population, compared to the non-PTSD population. Married officers constituted more than 60% of the PTSD population across all four services, most notably in the Army. Among the PTSD

population in the Army, 72% of them were married. It could be inferred that across all four services, married officers were more likely to be diagnosed with PTSD (69%), compared to the 31% who were single.

The race distribution in Table 5.1 shows that the overall officer sample was predominately white for all the four services. White officers (except in the Marine Corps) appeared to be relatively less affected by PTSD. For the Army, Air Force and Navy, the percentage of white officers in the PTSD population (73%, 78% and 80% respectively) were lower than the percentage of white officers in the non-PTSD population (77%, 83% and 83% respectively). On the other hand, there was a higher percentage of black officers in the Army and Air Force's PTSD population (14% and 9% respectively), compared to their non-PTSD population (12% and 6% respectively). Nonetheless, the descriptive statistics did not indicate that any particular race is significantly more or less vulnerable to PTSD.

Table 5.1 shows that the average age for the PTSD population was higher than the average age for the non-PTSD population across all four services. The average age for the overall PTSD population was 38 while the average age for the overall non-PTSD population was 35. This could indicate that the risk of PTSD for officers increased with age, particularly during the late thirties. The positive relationship between PTSD risk and age could be due to the fact that an older officer is more likely to have experienced more deployments, and hence potentially greater exposure to war trauma, compared to a younger officer.

2 Enlisted Population

The enlisted personnel data samples for the four services consisted of 2,966,729 unique EDIPN observations or 87.4% of the overall DEERS data files. Because the demographic characteristics and deployment and operational profiles of the enlisted personnel were significantly different from the officers, the

enlisted population was analyzed separately from the officers. The detailed breakdown of the demographic characteristics of the enlisted personnel data samples is shown in Table 5.2.

	Enlisted									
	Army		Air Force		Marine Corps		Navy		Total	
	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD
Sample Size	1,374,999		601,384		390,064		600,236		2,966,683	
Number of observations	1,354,012	20,987	597,536	3,848	385,588	4,476	595,011	5,225	2,932,147	34,536
% of observations / service	98.5%	1.5%	99.4%	0.6%	98.9%	1.1%	99.1%	0.9%	98.8%	1.2%
Sex										
Female	17.2%	19.5%	20.5%	53.2%	6.2%	13.0%	15.4%	41.7%	16.1%	25.8%
Male	82.8%	80.5%	79.5%	46.8%	93.8%	87.0%	84.6%	58.3%	83.9%	74.2%
Marital Status										
Single	57.9%	38.5%	49.3%	48.9%	69.9%	51.4%	57.1%	54.5%	57.6%	43.8%
Married	42.1%	61.5%	50.7%	51.1%	30.1%	48.6%	42.9%	45.5%	42.4%	56.2%
Race										
White	63.4%	65.5%	73.5%	73.3%	70.8%	71.5%	60.1%	62.4%	65.8%	66.7%
Black	21.1%	19.0%	16.3%	15.5%	11.9%	9.9%	20.5%	16.7%	18.8%	17.1%
Hispanic	6.2%	5.9%	3.0%	3.8%	7.0%	8.5%	6.4%	7.4%	5.7%	6.3%
Asian	3.7%	2.5%	2.2%	1.4%	2.6%	2.1%	5.3%	3.9%	3.6%	2.5%
Other races	5.6%	7.0%	4.9%	6.0%	7.7%	8.0%	7.6%	9.6%	6.1%	7.4%
Age										
Mean age (year)	27.2	29.6	28.7	27.7	23.3	24.6	27.0	26.9	26.9	28.4

Table 5.2. Summary Statistics of the DEERS Data Samples of the Four Services (Enlisted Personnel)

Table 5.2 shows that about 1.2% of the entire sample for the enlisted personnel (34,536 service members) was diagnosed with PTSD during the study period. This is higher than the corresponding rate of 0.5% for the officers in Table 5.1. In fact, the percentage of enlisted personnel diagnosed with PTSD is twice or more, than the percentage of officers diagnosed with PTSD for the respective services. For instance, in the Army, about 0.5% of its officers were diagnosed with PTSD, but 1.5% of its enlisted personnel were affected by PTSD. Similar to the officer population, the Army (1.5%) and Marine Corps (1.1%) also have a higher percentage of their enlisted population diagnosed with PTSD compared to the Air Force (0.6%) and Navy (0.9%).

Similar to the officer population, female enlisted personnel (Table 5.2) were more likely to be diagnosed with PTSD compared to the males across all four services. Females constituted a higher percentage of the enlisted personnel PTSD population, compared to the non-PTSD population across all services,

most notably for the Air Force. Female enlisted personnel constituted only 21% of the non-PTSD population in the Air Force, but they accounted for 53% of the PTSD cases in the Air Force.

Table 5.2 also shows that there is a higher percentage of PTSD population who are married, compared to the non-PTSD population, particularly for the Army and Marine Corps. Married enlisted personnel constituted 42% and 30% of the Army and Marine Corps' non-PTSD population respectively. However, 62% and 49% of the PTSD population in the Army and Marine Corps respectively, were married. A higher probability of being diagnosed with PTSD among the married personnel was observed in the officer population too.

The race distribution in Table 5.2 shows that the whites and the blacks are the two main race groups in both the PTSD and non-PTSD populations across all services. However, similar to the officer population, no single race group in the enlisted population appeared to be particularly susceptible to PTSD.

Compared to the officer population, the average age of the enlisted population across the different branches of services was much younger. The average age of the officer population was mid to late thirties, while the average age of the enlisted population was mid to late twenties. The younger average age of the enlisted population could be due to the fact that the enlisted population generally consisted of a larger number of junior and younger service members. The differences in the average age between the enlisted PTSD and non-PTSD population across the four services were also smaller, compared to the officers.

C. TREND ANALYSIS OF THE PREVALENCE OF PTSD ACROSS DIFFERENT BRANCHES OF THE ARMED SERVICES

The purpose of this section is to analyze the trends of PTSD incidences across the different branches of the armed services during the study period of FY2001 to FY2006. This thesis focuses on: (1) the trend of new cases of PTSD in each year and (2) the cumulative PTSD incidence rate for each year. For the purpose of this thesis, the cumulative PTSD incidence rate is defined as the

percentage of the study population who has been diagnosed with PTSD since FY2001, up to the respective study year. For example, the cumulative PTSD incidence rate for FY2005 will include all PTSD cases diagnosed between FY2001 up to FY2005.

Trend analyses were conducted for three different populations: (1) all active duty TRICARE beneficiaries during the study period FY2001 to FY2006, regardless of whether they were deployed or not; (2) those who were deployed overseas during the study period as indicated by the CTS data; and, (3) those who were deployed to Iraq and/or Afghanistan during the study period. As usual, we analyzed the officer and the enlisted populations separately. The rest of section C is organized as follows: Sections C1.1-1.4 present the trend analysis for the entire sample, sections C2.1-2.4 present the trend analysis for those who were deployed overseas, and sections C3.1-3.4 present the trend analysis for those who were deployed to Iraq and/or Afghanistan. Section C4.1 shows a summary table that compares the trend analyses across the three different populations.

1.1. New PTSD Cases among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers)

The annual TRICARE enrollment of the active service personnel across the different branches of services from FY2001 to FY2006, based on the DEERS dataset, is summarized in Table 5.3 below.

TRICARE Enrollment (Officers and Warrant Officers)					
FY	Army	Air Force	Marine	Navy	Total
2001	99,518	76,525	18,139	59,357	253,539
2002	108,411	85,021	20,285	64,717	278,434
2003	122,507	91,758	22,203	68,234	304,702
2004	130,399	90,709	22,294	65,629	309,031
2005	130,806	90,470	22,042	64,098	307,416
2006	130,708	89,103	21,979	63,404	305,194
Total	722,349	523,586	126,942	385,439	1,758,316

Table 5.3. Summary of TRICARE Enrollment (Officers and Warrant Officers) from FY2001 to FY2006

Table 5.3 shows a significant increase in the officer TRICARE enrollment for all services between FY2001 to FY2003. Thereafter, the TRICARE enrollment had remained relatively constant between FY2004 to FY2006. The increase in TRICARE enrollment coincided with the commencement of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). Overall, the officer TRICARE enrollment has increased from 253,539 in FY2001 to 305,194 in FY2006.

Figure 5.1 shows the number of new PTSD cases diagnosed among the entire active duty officer population who were enrolled in TRICARE between FY2001 to FY2006 for the four services. The number of new PTSD cases was obtained from the DEERS dataset.

Figure 5.1 shows a dramatically rising trend in the number of new PTSD cases diagnosed among the active duty TRICARE beneficiaries (officer and warrant officer) between FY2001 and FY2006, across all four services. The total number of new PTSD cases per year in the four services had remained fairly constant, below 200, between FY2001 to FY2003. However there was a surge from FY2004 onwards. In FY2006, 668 new cases were diagnosed.

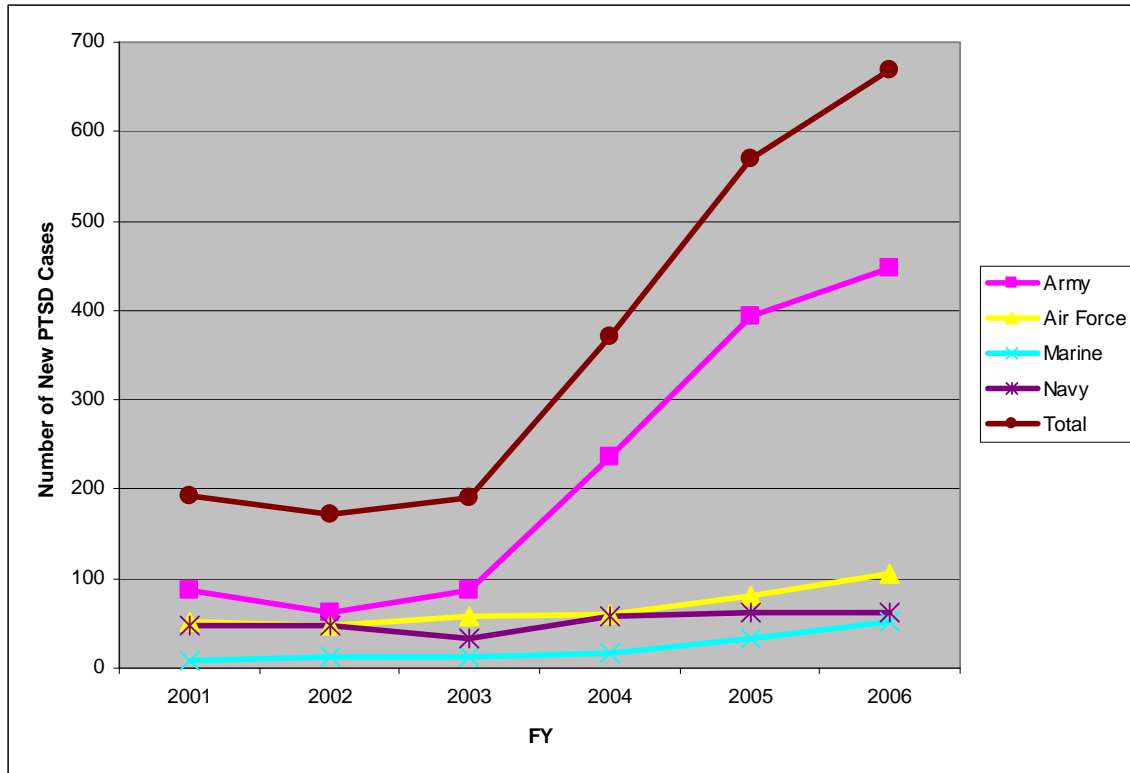


Figure 5.1. Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Diagnosed with PTSD between FY2001 and FY2006

A time lag between the increase in officer TRICARE enrollment (from FY2001 to FY2003) described in Table 5.1, and the surge in the number of new PTSD cases among the officer enrollment (from FY2004 onwards) depicted in Figure 5.1 was observed. After an individual's deployment and exposure to war-zone trauma, it is reasonable to expect a time lapse before the individual will seek treatment and be diagnosed clinically with PTSD. This could explain the time lag between the increase in officer enrollment and the surge in new PTSD cases.

The rising trend in the number of new PTSD cases was most pronounced in the Army and the Marine Corps. Since the start of the GWOT following the 9/11 incident, the number of new PTSD cases diagnosed per year in the Army has increased by 420% between FY2001 (86 cases) to FY2006 (448 cases). Similarly, the number of new PTSD cases diagnosed per year in the Marine

Corps has increased by 460%, from 9 cases in FY2001 to 51 cases in FY2006. Due to their operational and deployment profiles, personnel from the Army and Marine Corps were most likely to be deployed in ground combats and have greater exposure to war-zone trauma. Hence the rising trend in the number of new PTSD cases was most pronounced in the Army and Marine Corps, compared to the other two services.

Although the number of new PTSD cases has remained relatively low and stable for the Air Force and Navy, a slow but certainly rising trend could be observed in these two services too. Similarly to the Army and Marine Corps, the rising trend in the number of new PTSD cases in the Air Force and Navy was most prominent from FY2004 onwards.

1.2. New PTSD Cases among All Active Duty TRICARE Beneficiaries (Enlisted Personnel)

The breakdown for the annual TRICARE enrollment for the enlisted population across the four services is summarized in Table 5.4.

TRICARE Enrollment (Enlisted Personnel)					
FY	Army	Air Force	Marine	Navy	Total
2001	609,004	334,428	191,591	377,248	1,512,451
2002	678,452	385,949	206,620	392,209	1,663,230
2003	738,179	406,900	219,202	397,317	1,761,598
2004	785,395	398,091	219,917	378,782	1,782,185
2005	757,185	376,815	218,870	367,520	1,720,390
2006	751,546	366,578	218,247	362,490	1,698,861
Total	4,319,761	2,268,761	1,274,447	2,275,746	10,138,715

Table 5.4.. Summary of TRICARE Enrollment (Enlisted Personnel) from FY2001 to FY2006

Similar to officer enrollment, there was an increase in TRICARE enrollment for enlisted personnel following the 9/11 incident, from FY2001 to FY2003. From FY2004 to FY2006, the enlisted personnel enrollment had either remained constant or dipped slightly for the various services.

Figure 5.2 shows the number of new PTSD cases diagnosed among the enlisted TRICARE enrollees between FY2001 and FY2006 for the four services. Similar to the officer population, a rising trend in the number of new PTSD cases was observed across all four services, and a time lag between the increase in enlisted TRICARE enrollment and the surge in new PTSD cases was observed. The rising trend was most noticeable from FY2004 onwards, and the surge was most pronounced in the Army and Marine Corps. The number of new PTSD cases diagnosed per year in the Army increased by 550% between FY2001 (1,084 cases) to FY2006 (7,116 cases). Similarly, the number of new PTSD cases diagnosed per year in the Marine Corps increased by 380%, from 315 cases in FY2001 to 1,527 cases in FY2006. The surge in the number of new PTSD cases in the Army and Marine Corps is again likely due to their operational and deployment profiles.

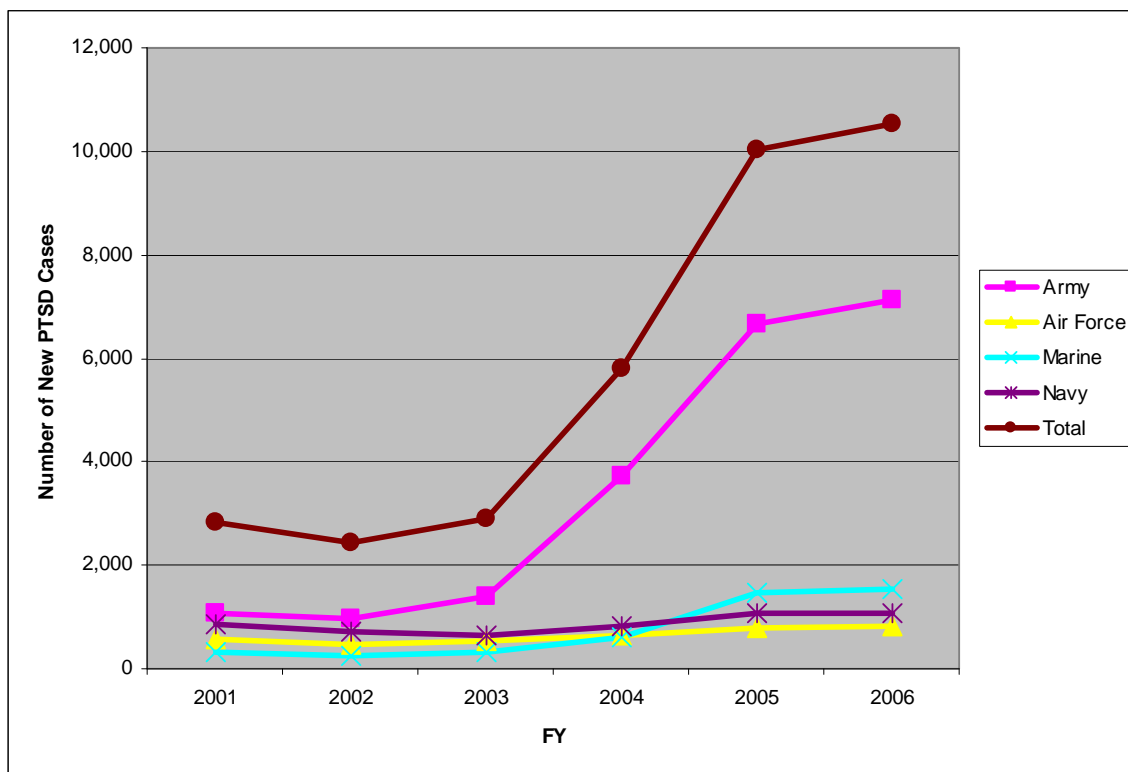


Figure 5.2. Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Diagnosed with PTSD Between FY2001 to FY2006

1.3. Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers)

Besides analyzing the number of new PTSD cases among the active duty service personnel, it would be beneficial to examine the cumulative trends of PTSD diagnoses among these personnel. PTSD is classified as a mental health illness. It often takes time for the medical conditions and symptoms related to PTSD to be diagnosed clinically and for its treatment to take effect.

Figure 5.3 shows the cumulative number of active duty TRICARE beneficiaries (officer and warrant officer) diagnosed with PTSD from FY2001 to FY2006. For instance, the cumulative number of PTSD cases (1,494) for all services in FY2005 includes all PTSD cases diagnosed from FY2001 up to, and including FY2005. Figure 5.3 shows that the number of new PTSD cases diagnosed each year increased at a growing rate for the entire U.S. military, as well as across the individual services, from FY2004 onwards. Among the four services, the rate of increase notably is most significant for the Army.

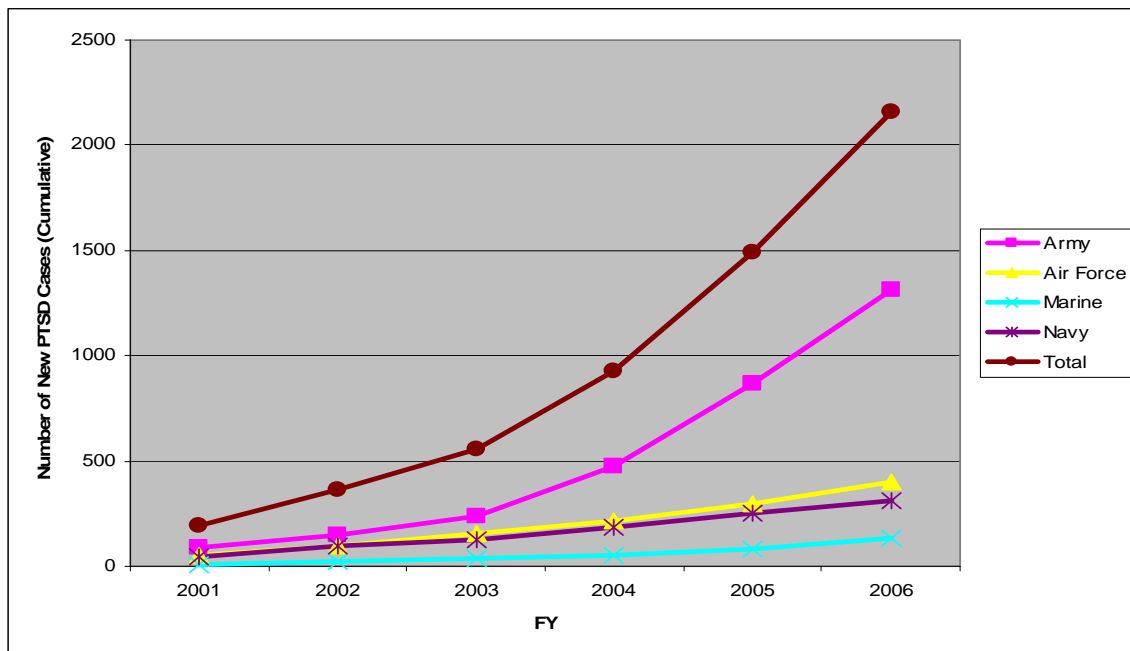


Figure 5.3. Cumulative Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Diagnosed with PTSD between FY2001 to FY2006

The corresponding cumulative percentage of active duty TRICARE beneficiaries (officer and warrant officer) diagnosed with PTSD between FY2001 and FY2006 is shown in Figure 5.4. For this thesis, the cumulative percentage of PTSD incidence refers to the percentage of the study population who has been diagnosed with PTSD since FY2001 up to the respective study year. The study population in this section refers to the entire TRICARE enrollment. For instance, the cumulative percentage of 1% for the Army in FY2006 indicates that 1% of the Army officer TRICARE enrollment in FY2006, have been diagnosed with PTSD between FY2001 and FY2006.⁴³

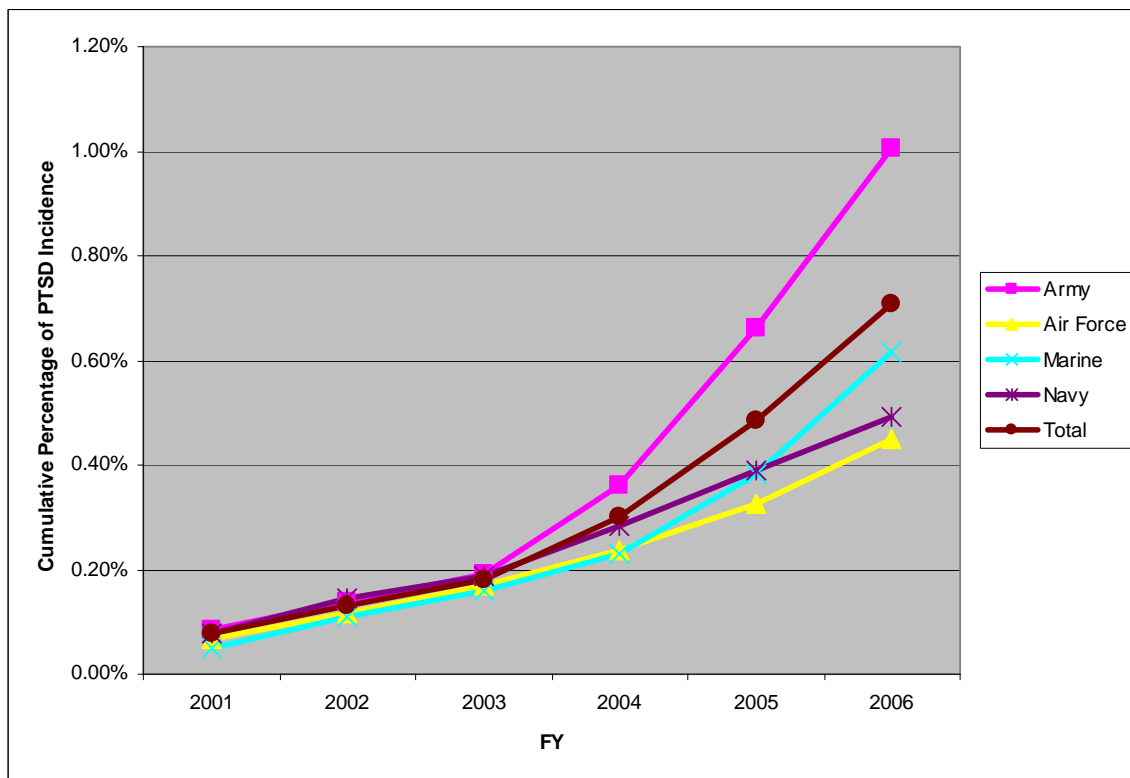


Figure 5.4. Cumulative Percentage of PTSD Incidence (Officers and Warrant Officers)

⁴³ The Army officer TRICARE enrollment in FY2006 was 130,708. A total of 1,314 cases of PTSD were diagnosed from FY2001 to FY2006 in the Army. This results in a cumulative percentage of 1.01%.

The officer population from the Army has the highest cumulative percentage of PTSD incidence among the four services throughout the entire study period (except FY2002). Interestingly, the officer population from the Navy has the second highest cumulative percentage of PTSD incidence (except FY2006). The relatively high cumulative percentage of PTSD incidence in the Navy might be partly attributed to the slight decline in its TRICARE officer enrollment and increasing number of new PTSD diagnoses, particularly from FY2003 onwards.

The cumulative percentage of PTSD incidence in FY2006 was 0.7% for the four services. Among the services, it ranged from 0.5% for the Air Force to 1% for the Army. These low cumulative percentages may be attributed to the fact that the study population in this section included all active duty TRICARE beneficiaries, regardless of their deployment history during the study period. The analysis in the next section shows that a significant portion of these TRICARE beneficiaries were not deployed overseas during the study period. This caused the cumulative percentage of PTSD incidence to be lower than one would expect, based on current literature.

1.4. Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Enlisted Personnel)

Figure 5.5 shows that the trend in the cumulative number of PTSD cases for enlisted personnel is similar to the trend in the officer population. The cumulative number of PTSD cases increased at a growing rate for every service from FY2004 onwards, i.e., the number of new PTSD cases diagnosed each year increased. The cumulative number of PTSD cases for the enlisted personnel in the U.S. military grew from 2,835 cases in FY2001 to 34,536 cases in FY2006. The rate of increase is again most pronounced in the Army. The cumulative number of PTSD cases in the Army has increased from 1,084 in FY2001 to 20,987 in FY2006.

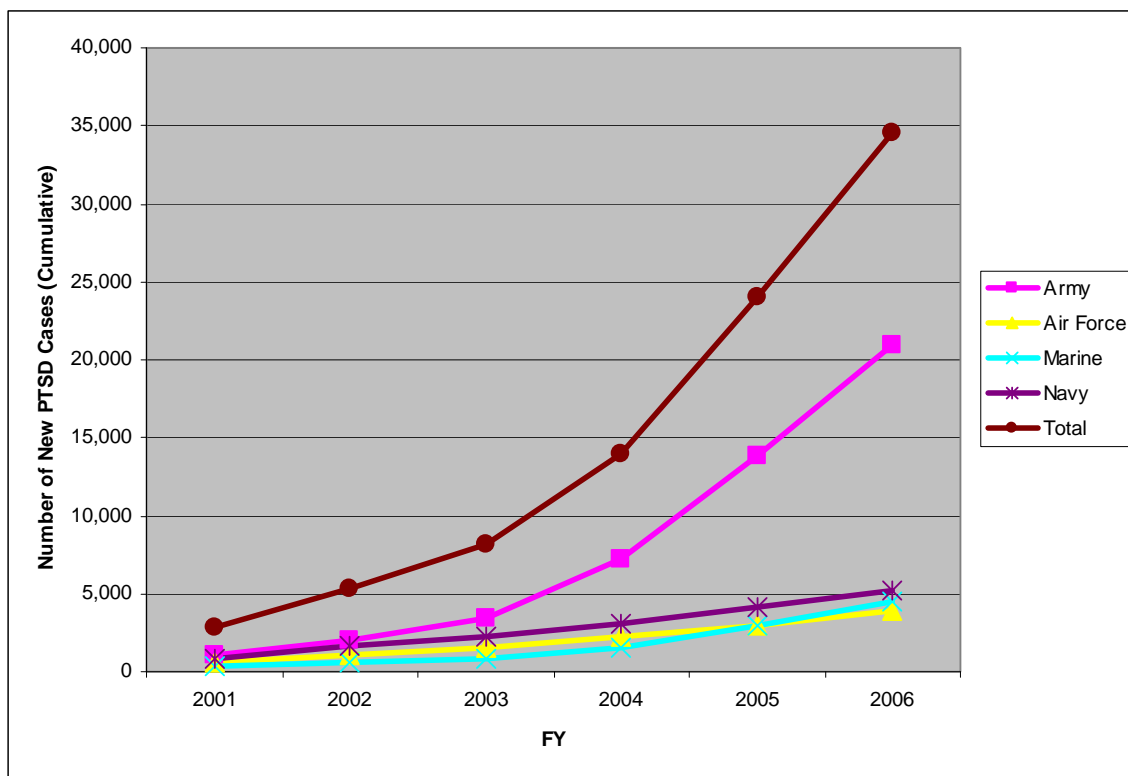


Figure 5.5. Cumulative Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Diagnosed with PTSD between FY2001 and FY2006

The corresponding cumulative percentage of PTSD incidence for the enlisted personnel is shown in Figure 5.6. These cumulative percentages of PTSD incidence reflect the percentage of TRICARE enrollment for the enlisted personnel diagnosed with PTSD between FY2001 up to the respective study year. A comparison of Figure 5.4 and Figure 5.6 reveals that the cumulative percentage of PTSD incidence for enlisted personnel is at least twice that of the officers, across all services. This suggests that the enlisted population was more susceptible to PTSD, compared to the officers, as noted in current literature.

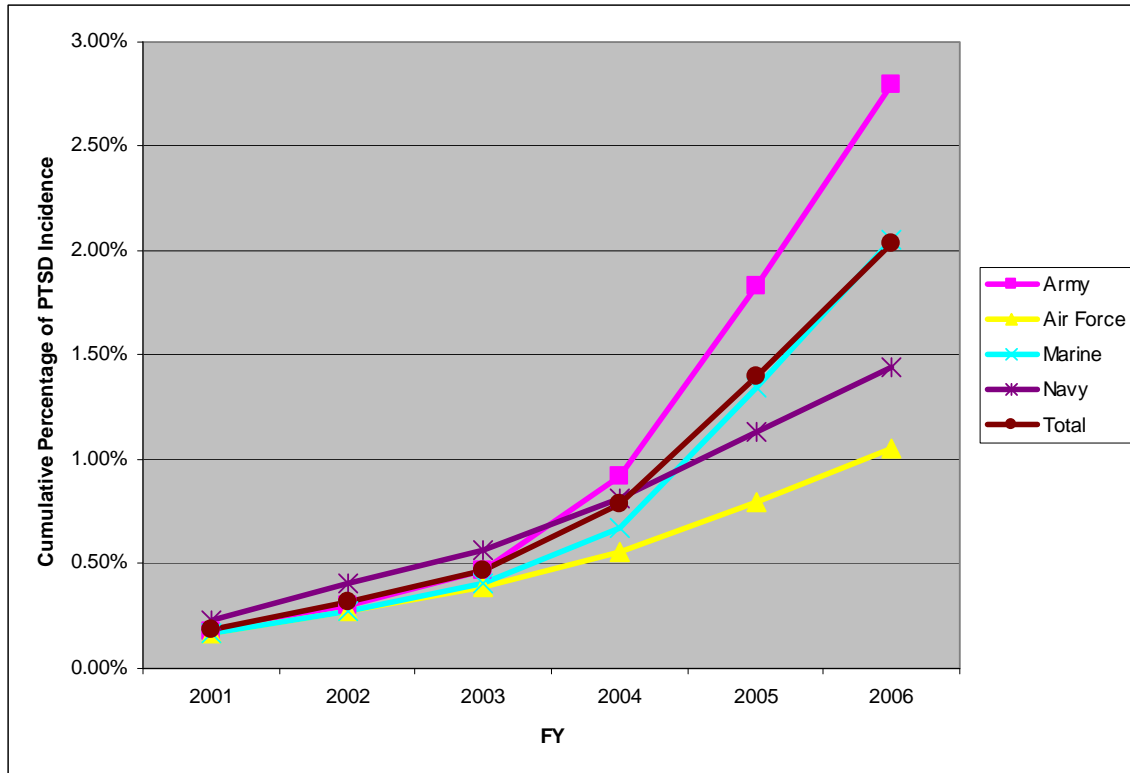


Figure 5.6. Cumulative Percentage of PTSD Incidence (Enlisted Personnel)

Despite the surge in the number of new PTSD cases, the cumulative percentage of PTSD across all the services appeared relatively low, compared to findings in current literature. The cumulative percentage of PTSD for the enlisted personnel in the four services was 2% in FY2006. As explained in the analysis for the officer population, the cumulative percentages in this section are based on the entire TRICARE enrollment, regardless of whether they were deployed overseas during the study period. Even with the ongoing GWOT, a significant portion of the enrollment was not deployed overseas during the period. This lowered the cumulative percentage of PTSD incidence.

Among the enlisted population, the rate of increase in the number of new PTSD cases appeared to be greater in the Army and Marine Corps. For the enlisted personnel in the Army, the cumulative percentage of PTSD incidence has increased from 0.2% in FY2001 to 2.8% in FY2006, while the corresponding

percentage for the Marine Corps has increased from 0.2% to 2% in the same time span. The rate of increase in the number of new PTSD cases in the Air Force and Navy appeared to be flatter. The cumulative percentages for the Air Force and Navy have increased from 0.2% and 0.3% in FY2001 to 1.1% and 1.4% in FY2006 respectively. However, these percentages may not truly reflect the effect of the GWOT or overseas deployments on the probability of being diagnosed with PTSD among the services, because the study population in this section consisted of the entire TRICARE population, regardless of deployment history. In order to study the effect of deployments on the probability of being diagnosed with PTSD, the following two sections will consider the deployment history of the TRICARE beneficiaries in their analyses.

2.1. New PTSD Cases Among Active Duty TRICARE Beneficiaries (Officer and Warrant Officer) Who Were Ever Deployed Overseas

In order to better understand the effect of overseas deployment on the likelihood of being diagnosed with PTSD, this section restricts the study population to the TRICARE beneficiaries who were ever deployed overseas between FY2001 to FY2006. The number of TRICARE beneficiaries (Officers and Warrant Officers) who were ever deployed overseas during the study period is tabulated in Table 5.5.

TRICARE Enrollment (Officers and Warrant Officers) Who Were Ever Deployed Overseas					
FY	Army	Air Force	Marine	Navy	Total
2001	35,379	39,256	8,681	19,900	93,216
2002	42,790	34,367	10,457	22,171	109,785
2003	50,948	37,597	11,908	23,484	123,937
2004	55,835	37,903	12,229	23,767	129,734
2005	54,861	37,017	12,306	23,748	127,932
2006	53,110	35,503	11,844	23,319	123,776
Total	292,923	211,643	67,425	34,184	708,380

Table 5.5. Summary of TRICARE Enrollment (Officers and Warrant Officers) Who Were Ever Deployed Overseas from FY2001 to FY2006

The general trend in the number of TRICARE officer beneficiaries who were ever deployed overseas was similar to the trend observed in the officer TRICARE enrollment in the previous section. The number of officers ever deployed overseas (except for the Air Force) increased from FY2001 to FY2003, and thereafter remained relatively constant or declined slightly. The number of officers ever deployed overseas in the four services had increased by more than 30,000, from 93,216 in FY2001 to 123,776 in FY2006. Among the four services, the increase was most noticeable in the Army. The number of Army officers ever deployed overseas increased by 50% from 35,379 to 53,110 over the study period.

A comparison of Table 5.3 and Table 5.5 shows that the percentage of officers deployed overseas has increased from all services except the Air Force. For instance, in FY2001, 35,379 or 36% of the 99,158 Army officers had ever been deployed overseas. In FY2006, among the 130,708 Army officers, 41% or 53,110 of them had ever been deployed overseas. The percentage of officers deployed for the Marine Corps and Navy had also increased slightly, from 48% and 34% respectively in FY2001, to 54% and 37% in FY2006. The percentage for the Air Force however declined from 51% in FY2001 to 40% in FY2006.

Figure 5.7 shows the number of new PTSD cases among the TRICARE beneficiaries (officer) who were ever deployed overseas between FY2001 to FY2006. A surge from FY2003 onwards was evident across all services, particularly for the Army. The number of new PTSD cases diagnosed per year increased from 26 cases in FY2003, to 435 cases in FY2006 for the four services, while the Army registered an increase from 12 new cases in FY2003 to 311 new cases in FY2006. Interestingly, the Air Force had the second highest number of new PTSD cases (54) in FY2006, whereas both the Marine Corps and Navy had less than 40 new cases each. A time lag between the increase in the number of officers ever deployed overseas, and the surge in new PTSD cases was again observed.

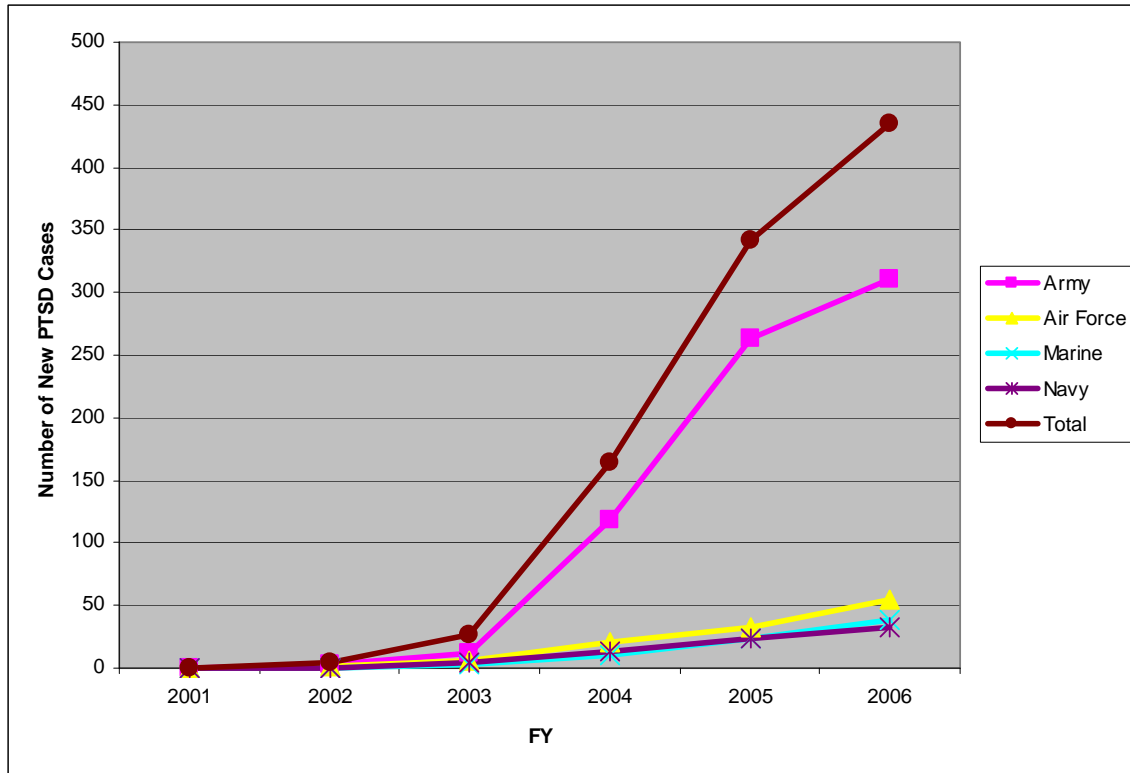


Figure 5.7. Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed Overseas and Diagnosed with PTSD between FY2001 and FY2006

Tables 5.3 and 5.5 show that in FY2006, 123,776 or 40% of the 305,194 officers in the services were ever deployed overseas. However, the officers who were ever deployed overseas constituted 65% or 435 of the 668 new PTSD cases in FY2006. This disproportionate distribution was observed across all services, and was most prominent in the Army and Marine Corps. In FY2006, 41% and 54% of the officers in the Army and Marine Corps were ever deployed respectively, but these officers accounted for 69% and 75% of the new PTSD cases in their services. Similarly, about 40% of the officers in the Air Force and Navy were ever deployed, but they constituted 51% of the new PTSD cases in their services. These clearly point to the increase in the probability of being diagnosed with PTSD due to overseas deployments.

2.2. New PTSD Cases Among Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas

Table 5.6 summarizes the number of TRICARE enlisted beneficiaries who were ever deployed overseas between FY2001 and FY2006.

TRICARE Enrollment (Enlisted Personnel) Who Were Ever Deployed Overseas					
FY	Army	Air Force	Marine	Navy	Total
2001	186,244	142,746	64,183	176,635	569,808
2002	240,300	174,677	86,484	201,645	703,106
2003	293,917	189,606	104,941	217,034	805,498
2004	318,579	188,442	111,866	215,755	834,662
2005	296,001	180,531	103,872	210,650	782,054
2006	267,501	166,283	88,668	181,173	703,625
Total	1,602,542	1,042,285	560,014	1,193,912	4,398,753

Table 5.6. Summary of TRICARE Enrollment (Enlisted Personnel) Who Were Ever Deployed Overseas from FY2001 to FY2006

Table 5.6 shows that the GWOT has clearly increased the number of enlisted personnel who were ever deployed across all services. The number of enlisted personnel who were ever deployed was 569,808 in FY2001, and the corresponding number in FY2006 was 703,625. The Army and Marine Corps had the largest increase in the number of enlisted personnel who were ever deployed, based on the numbers for the start and end of the study period.

Similar to the officer population, the percentage of enlisted personnel who were ever deployed also increased due to the GWOT. In FY2001, 569,808 or 38% of the 1,512,451 enlisted personnel from the four services were ever deployed. In FY2006, 41% or 703,625 of the 1,698,861 enlisted personnel were ever deployed. The percentage increase for the enlisted personnel was, however, smaller than the percentage increase for the officers.

Figure 5.8 shows the number of new PTSD cases diagnosed among the enlisted personnel who were ever deployed overseas. Similar to the officer population, a surge was observed from FY2003 onwards across all services. The number of new PTSD cases for all services surged from 609 in FY2003 to 7,452

in FY2006. The magnitude of the surge was again larger for the Army and Marine Corps, compared to the Air Force and Navy. The number of new PTSD cases in the Army and Marine Corps increased from 320 and 86 respectively in FY2003 to 5,332 and 1,159 in FY2006.

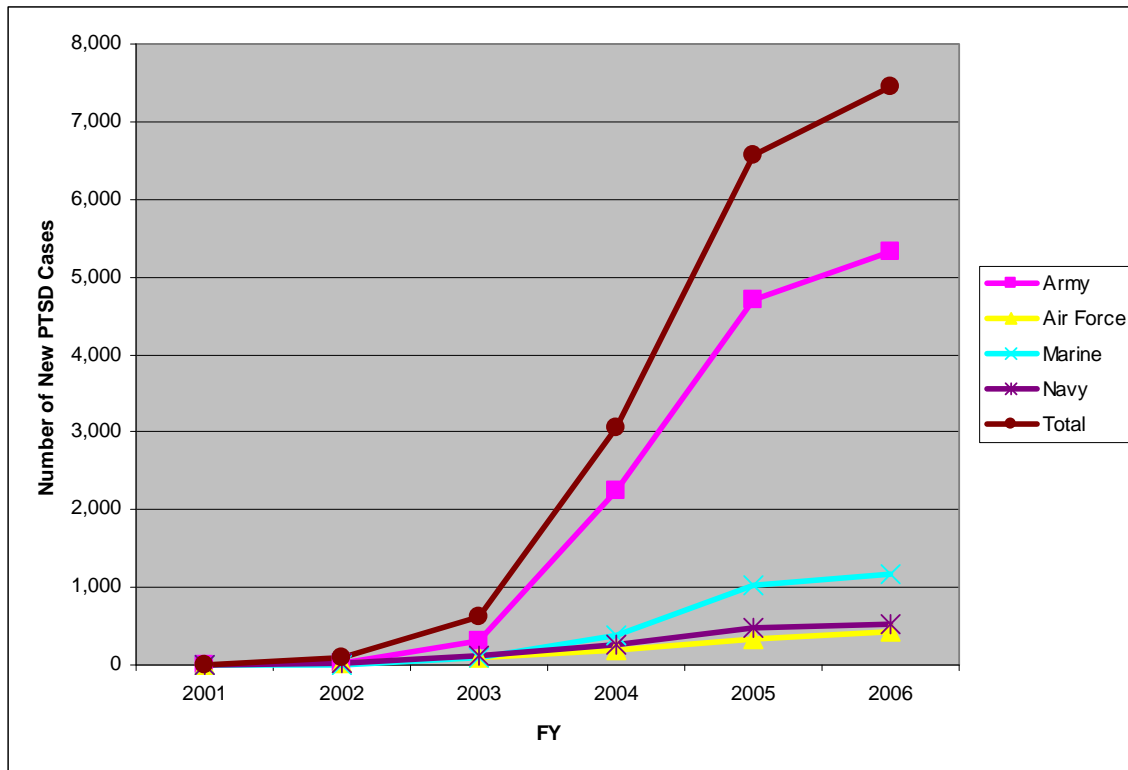


Figure 5.8. Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas and Diagnosed with PTSD Between FY2001 and FY2006

Similar to the officer population, the enlisted personnel who were ever deployed overseas also constituted a disproportionately high percentage of the new PTSD cases diagnosed across all services, except the Navy. In FY2006, 703,625 or 41% of the 1,698,861 enlisted personnel in the four services were ever deployed overseas. However, they accounted for 7,452 or 71% of the 10,540 new PTSD cases. The uneven distribution was most significant in the Army and Marine Corps. About 40% of the enlisted personnel in the Army and Marine Corps were ever deployed overseas, but they accounted for about 75% of the new PTSD cases in their services in FY2006. On the other hand, the enlisted

personnel in the Air Force and Navy who were ever deployed overseas, constituted a proportionate percentage of the new PTSD cases in their services. This suggests that the effect of overseas deployments on the likelihood of being diagnosed with PTSD might be less severe on the enlisted personnel in the Air Force and Navy, compared to their counterparts in the Army and Marine Corps, as hypothesized in this thesis.

2.3. Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed Overseas

Figures 5.9 and 5.10 show the cumulative number of PTSD diagnoses and the cumulative percentage of PTSD incidences among the officers who were ever deployed overseas. The previous section noted that the cumulative percentage of PTSD incidence for the entire TRICARE beneficiaries (officer) for the four services was 0.7% in FY2006, i.e. 0.7% of the officer population in the U.S. military in FY2006 had been diagnosed with PTSD between FY2001 to FY2006. This cumulative percentage of PTSD incidences increased to 0.8% when the study population was restricted to only those officers who were ever deployed overseas. As seen from Figure 5.10, this percentage increase was primarily attributable to the Army. The cumulative percentage of PTSD incidence for the Army increased from 1% to 1.3% when the deployment histories of the officers were taken into consideration, while the cumulative percentage for the other three services remained relatively unchanged. This indicates that the effect of overseas deployment on the probability of being diagnosed with PTSD may differ across the services.

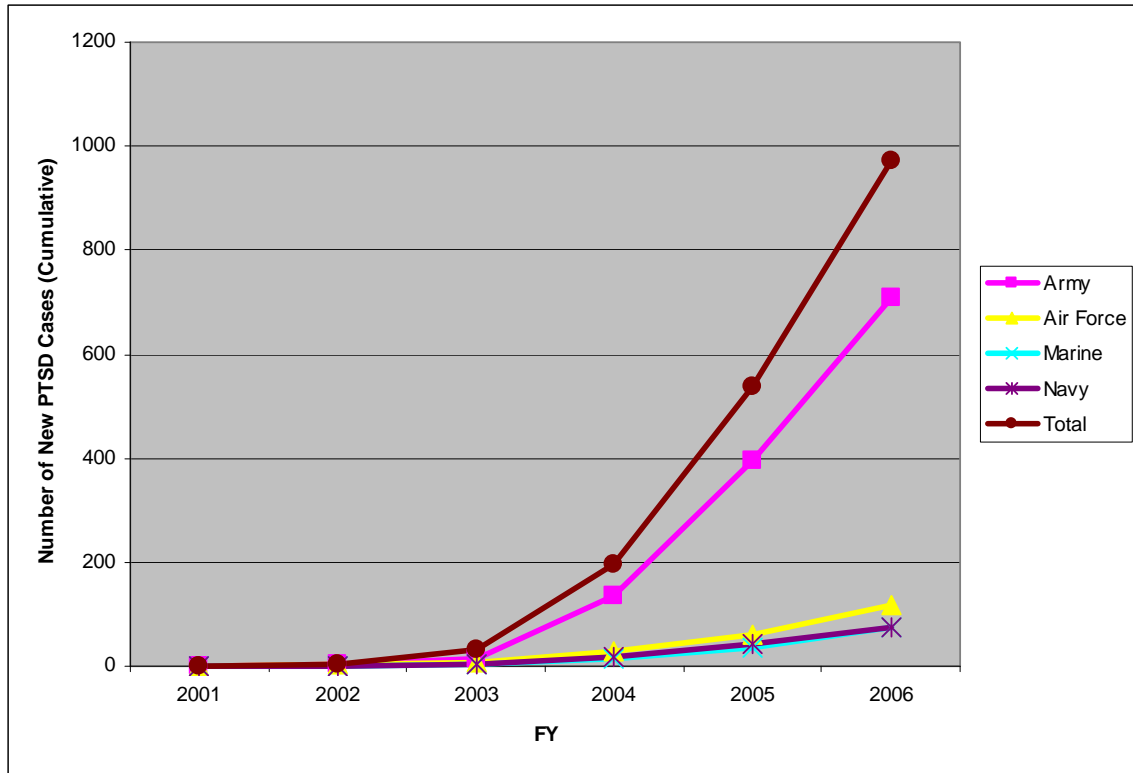


Figure 5.9. Cumulative Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed Overseas and Diagnosed with PTSD between FY2001 and FY2006

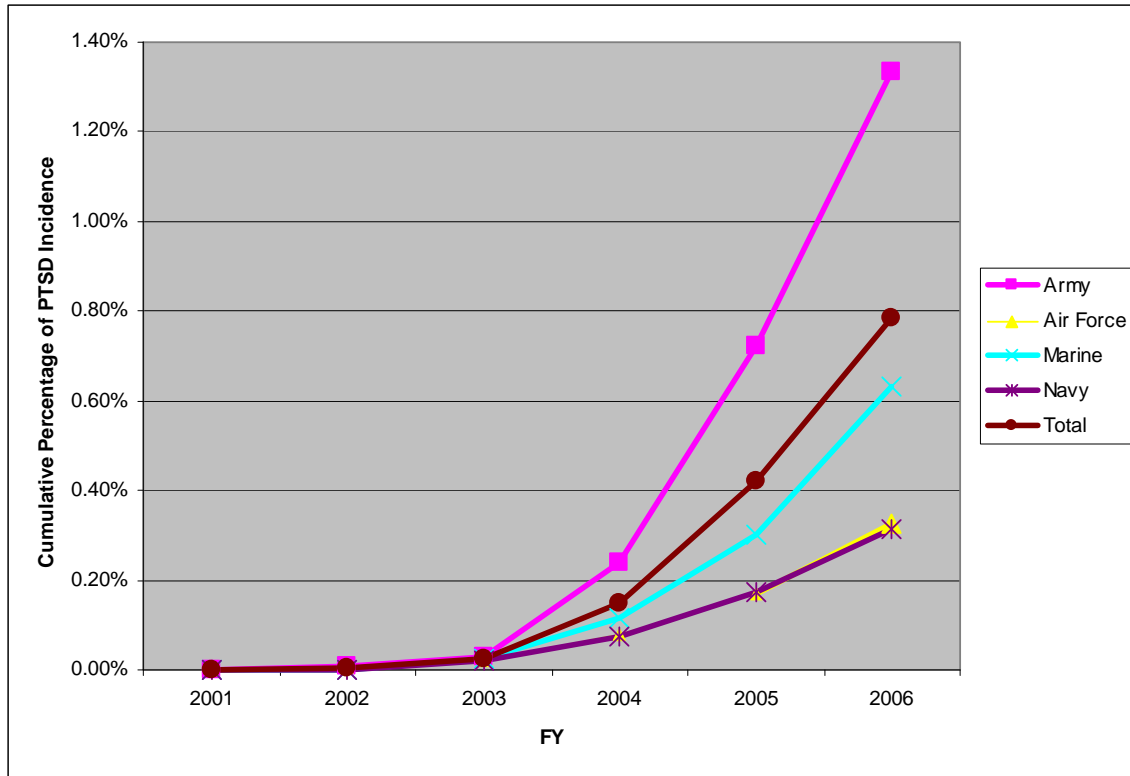


Figure 5.10. Cumulative Percentage of PTSD Incidence (Officers and Warrant Officers Who Were Ever Deployed Overseas)

2.4. Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas

Figures 5.11 and 5.12 show the cumulative number of PTSD diagnose and the cumulative percentage of PTSD incidences among the enlisted personnel who were ever deployed overseas. In FY2006, the cumulative percentage of PTSD incidence for the enlisted personnel in the four services increased from 2% (for the entire TRICARE enlisted beneficiaries in the previous section), to 2.5% when the deployment histories of the enlisted personnel were taken into account, and the study population was restricted to only those enlisted personnel who were ever deployed overseas. Among the services, the cumulative percentage for the Army and Marine Corps had both increased, from

2.8% and 2.1% to 4.7% and 3% respectively. On the other hand, the cumulative percentage for the Air Force and Navy had decreased from 1.1% and 1.4% to 0.7% and 0.8% respectively.

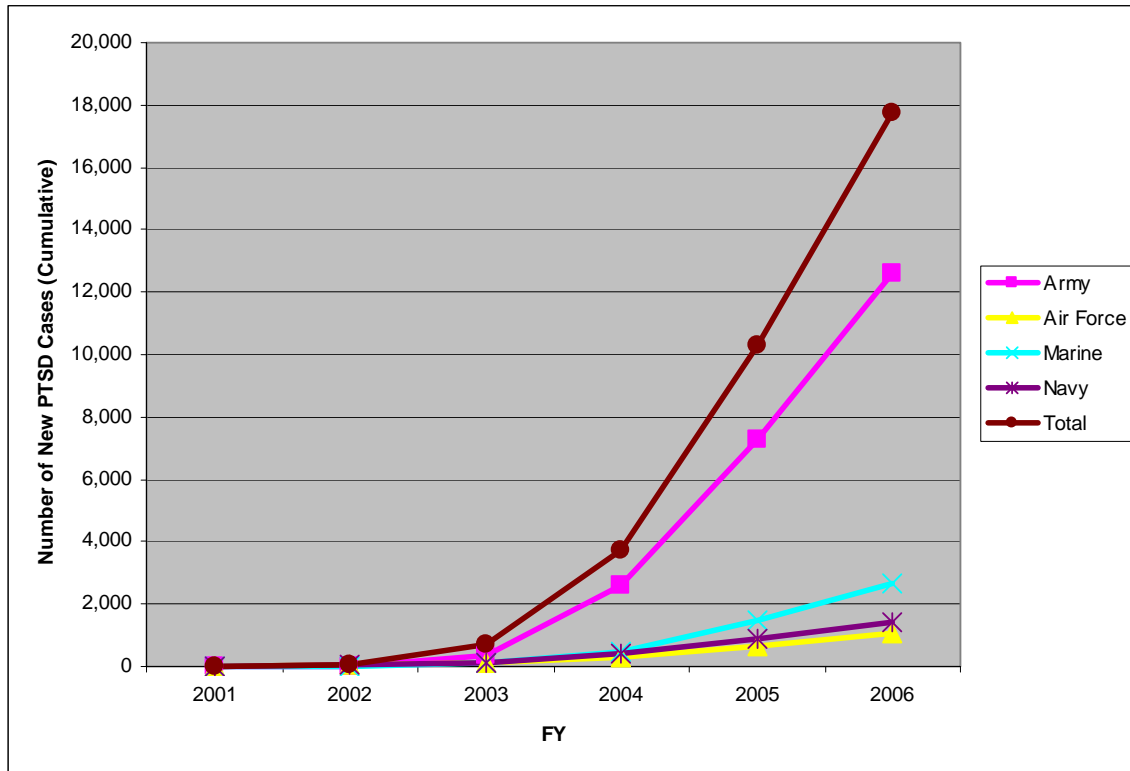


Figure 5.11. Cumulative Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed Overseas and Diagnosed with PTSD between FY2001 and FY2006

The different changes in the cumulative percentages suggest that the overseas deployment effect may differ across the services. In addition, the magnitude of the changes in the cumulative percentages for the enlisted personnel was larger than the changes for the officers. This indicates that the effect of overseas deployments may be more pronounced in the enlisted population, than in the officer population.

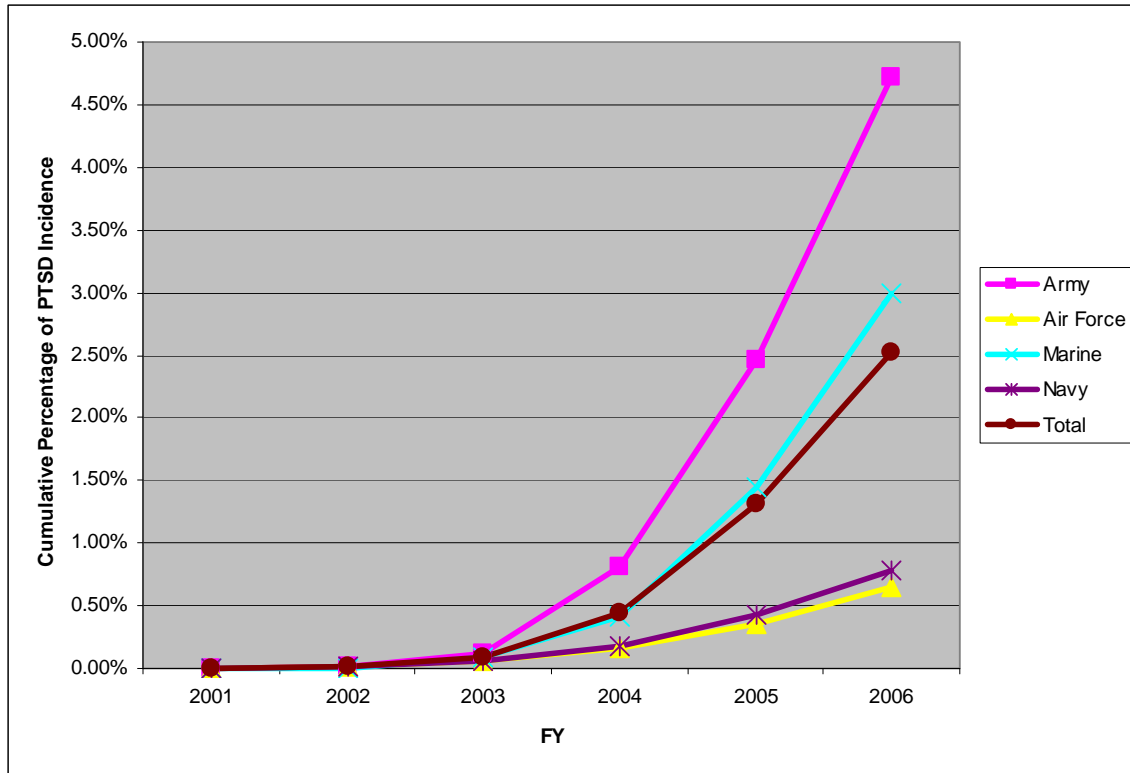


Figure 5.12. Cumulative Percentage of PTSD Incidence (Enlisted Personnel Who Were Ever Deployed Overseas)

This section has discussed the effect of overseas deployments on the likelihood of developing PTSD, through the changes in the cumulative percentage of PTSD incidences when the study population was restricted to only those TRICARE beneficiaries who were ever only deployed overseas. The crux of the GWOT is in Afghanistan and Iraq (OEF and OIF). Hence, in order to study the effect of the GWOT, the next section will further restrict the study population to only those who were ever deployed to Afghanistan and/or Iraq.

3.1. New PTSD Cases Among Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq

This section will specifically examine the effect of deployments to Afghanistan and/or Iraq by restricting the study population to the TRICARE beneficiaries who were ever deployed to Afghanistan or Iraq between FY2001 to

FY2006. Table 5.7 summarizes the number of officers who were ever deployed to Afghanistan and/or Iraq during the study period.

TRICARE Enrollment (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq					
FY	Army	Air Force	Marine	Navy	Total
2001	17,424	3,623	2,191	918	24,156
2002	20,505	4,275	2,764	1,065	28,609
2003	23,438	4,867	3,397	1,136	32,838
2004	26,164	5,333	3,773	1,155	36,425
2005	26,555	5,436	4,051	1,175	37,217
2006	25,960	5,356	3,987	1,232	36,535
Total	140,046	28,890	20,163	6,681	195,780

Table 5.7. Summary of TRICARE Enrollment (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq between FY2001 and FY2006

Table 5.7 shows an increasing trend in the number of officers who were ever deployed to Afghanistan and/or Iraq across all services. The number of officers who were ever deployed to Afghanistan and/or Iraq has increased from 24,156 in FY2001 to 36,535 in FY2006. The increase was most significant in the Marine Corps. The number of officers ever deployed to Afghanistan and/or Iraq increased by 82%, from 2,191 in FY2001 to 3,987 in FY2006.

A comparison of Tables 5.3, 5.5, and 5.7 provides insight into the deployment pattern for the officer population. The previous section had noted that 123,776 or 40% of the TRICARE officer enrollment (305,194) for the four services in FY2006 were ever deployed overseas. Of these officers who were ever deployed overseas, 36,535 or 30% were ever deployed to Afghanistan and/or Iraq. In FY2001, only 24,156 or 26% of the 93,126 officers who were ever deployed overseas, were ever deployed to Afghanistan and/or Iraq. This indicated that deployments to Afghanistan and/or Iraq constituted an increasing percentage of the overseas deployments for officers due to the GWOT. Among the four services, the larger percentage increase was observed in the Air Force and Marine Corps. In FY2001, among the officers ever deployed overseas, 9% of the officers in the Air Force and 25% of their counterparts in the Marine Corps,

were ever deployed to Afghanistan and/or Iraq. In FY2006, the percentage increased to 15% and 34% respectively.

Figure 5.13 shows the number of new PTSD cases among the officers who were ever deployed to Afghanistan and/or Iraq. The surge in the number of new PTSD cases for the Army is most noticeable. Similar to the previous sections, a time lag between the increased deployments to Afghanistan and/or Iraq and a surge in new PTSD cases was observed.

It was noted above that in FY2006, 36,535 or 30% of the officers who were ever deployed overseas, were ever deployed to Afghanistan and/or Iraq. However, these officers who were ever deployed to Afghanistan and/or Iraq, accounted for 277 or 64% of the 435 new PTSD cases diagnosed among officers who were ever deployed overseas. This suggests that the officers, who were ever deployed to Afghanistan and/or Iraq, were more susceptible to PTSD, compared to officers who were ever deployed to overseas locations other than Afghanistan and/or Iraq.

The adverse effect of deployments to Afghanistan and/or Iraq on the officer population was even more obvious if the entire TRICARE officer enrollment was taken into consideration, i.e., including those who were never deployed overseas during the study period. In FY2006, 36,535 or 12% of the entire TRICARE officer beneficiaries were ever deployed to Afghanistan and/or Iraq, but they constituted 277 or 41% of the 668 new PTSD cases among the entire group of TRICARE officer beneficiaries.

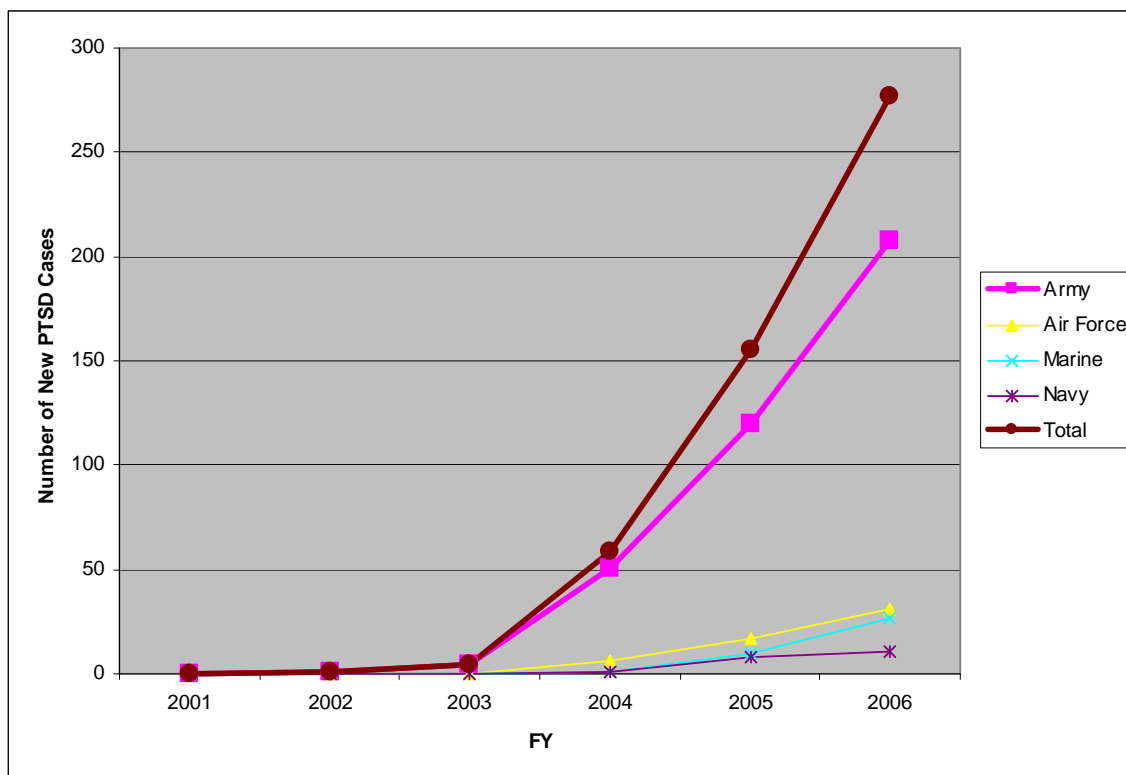


Figure 5.13. Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD Between FY2001 and FY2006

3.2. New PTSD Cases Among Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq

Table 5.8 summarizes the number of TRICARE enlisted beneficiaries who were ever deployed to Afghanistan and/or Iraq. A general increasing trend can be observed from Table 5.8. The number of enlisted personnel who were ever deployed to Afghanistan and/or Iraq had increased from 139,492 in FY2001, to 230,974 in FY2006, i.e. a 66% increase. Interestingly, the Air Force, Marine Corps and Navy all had a higher percentage increase in the number of enlisted personnel ever deployed to Afghanistan and/or Iraq, than the Army. The percentage increase for the Air Force, Marine Corps and Navy between FY2001 and FY2006 was 70%, 208% and 64% respectively, compared to 48% for the Army. The huge percentage increase for the Air Force, Marine Corps and Navy is

partly due to their small number of enlisted personnel ever deployed to Afghanistan and/or Iraq in FY2001.

TRICARE Enrollment (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq					
FY	Army	Air Force	Marine	Navy	Total
2001	105,623	17,080	12,829	3,960	139,492
2002	138,212	22,883	20,843	4,821	186,759
2003	162,808	26,507	30,443	5,589	225,347
2004	179,486	29,332	39,030	6,160	254,008
2005	170,836	29,971	41,611	6,691	249,109
2006	155,813	29,187	39,491	6,483	230,974
Total	912,778	154,960	184,247	33,704	1,285,689

Table 5.8. Summary of TRICARE Enrollment (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq between FY2001 and FY2006

Similar to that of the officer population, among the enlisted personnel who were ever deployed overseas, a growing percentage of them were deployed to Afghanistan and/or Iraq. Based on Tables 5.6 and 5.8, in FY2001, 139,492 or 24% of the 569,808 enlisted personnel who were ever deployed overseas, were ever deployed to Afghanistan and/or Iraq. In FY2006, it had increased to 33%, i.e., among the 703,625 enlisted personnel ever deployed overseas, 230,974 of them were ever deployed to Afghanistan and/or Iraq. This increasing percentage is most significant in the Marine Corps. In FY2001, 12,829 or 20% of the 64,183 enlisted personnel in the Marine Corps ever deployed overseas were ever deployed to Afghanistan and/or Iraq. In FY2006, among the 88,668 enlisted personnel ever deployed overseas, 45% or 39,491 of them were ever deployed to Afghanistan and/or Iraq.

Figure 5.14 shows the number of new PTSD cases among the enlisted personnel who were ever deployed to Afghanistan and/or Iraq. Similar to the officer population, the enlisted personnel who were ever deployed to Afghanistan and/or Iraq accounted for a disproportionately high percentage of the new PTSD among the enlisted personnel who were ever deployed overseas. As noted above, in FY2006, the number of enlisted personnel ever deployed to

Afghanistan and/or Iraq accounted for 33% of the enlisted personnel who were ever deployed overseas. However, these enlisted personnel ever deployed to Afghanistan and/or Iraq constituted 5,107 or 68% of the 7,452 new PTSD cases diagnosed among the enlisted personnel ever deployed overseas.

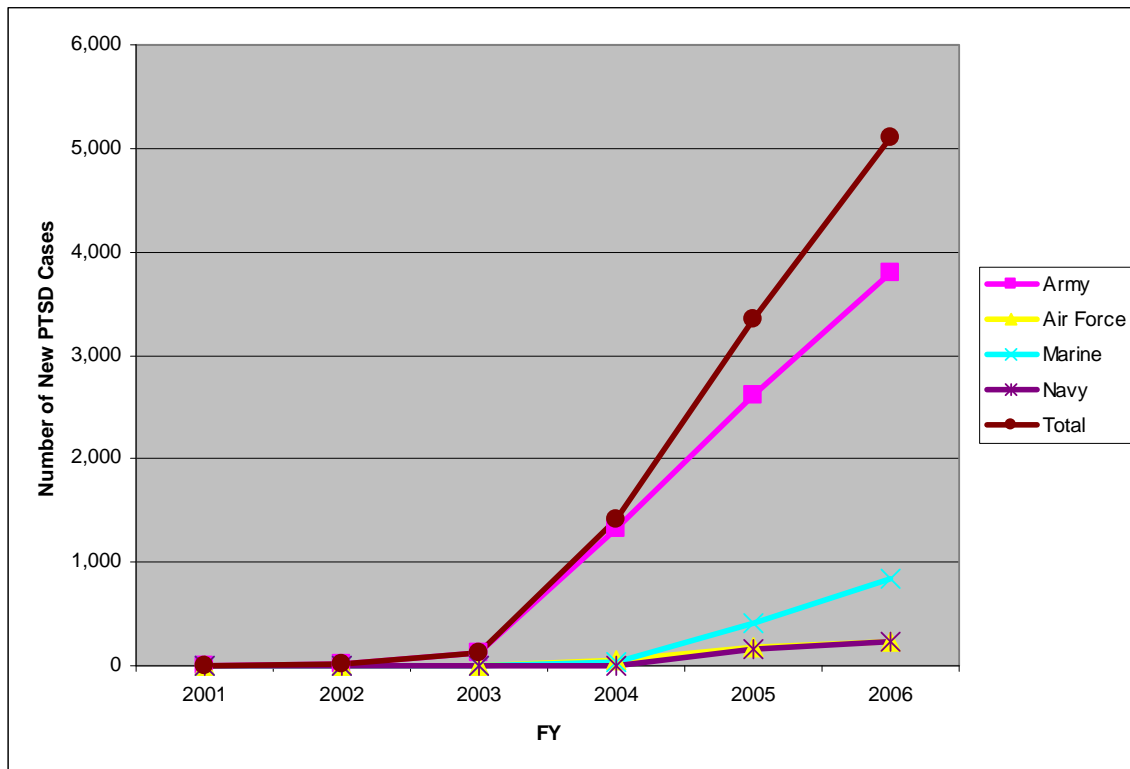


Figure 5.14. Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD between FY2001 and FY2006

From Table 5.2, the number of TRICARE enlisted enrollment in FY2006 for all services totaled 1,698,861, 14% or 230,974 of them were ever deployed to Afghanistan and/or Iraq. Yet they accounted for 48% or 5,107 of the 10,540 new PTSD cases diagnosed among all the enlisted personnel. This shows the effect of deployments to Afghanistan and/or Iraq on the probability of being diagnosed with PTSD.

3.3. Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq

The increased tempo of OEF and OIF in Afghanistan and Iraq between the years 2003 to 2005 has exerted its toll on the military personnel who were deployed for missions in the GWOT. Figure 5.15 shows the cumulative number of PTSD cases among officers ever deployed to Afghanistan and/or Iraq. The cumulative number of PTSD cases rose at an increasing rate across all services from FY2003 onwards. The increasing rate was most notable in the Army. Among the Army officers ever deployed to Afghanistan and/or Iraq, only 5 cases of PTSD was diagnosed between FY2001 up to FY2003. By FY2006, a total of 384 cases were diagnosed.

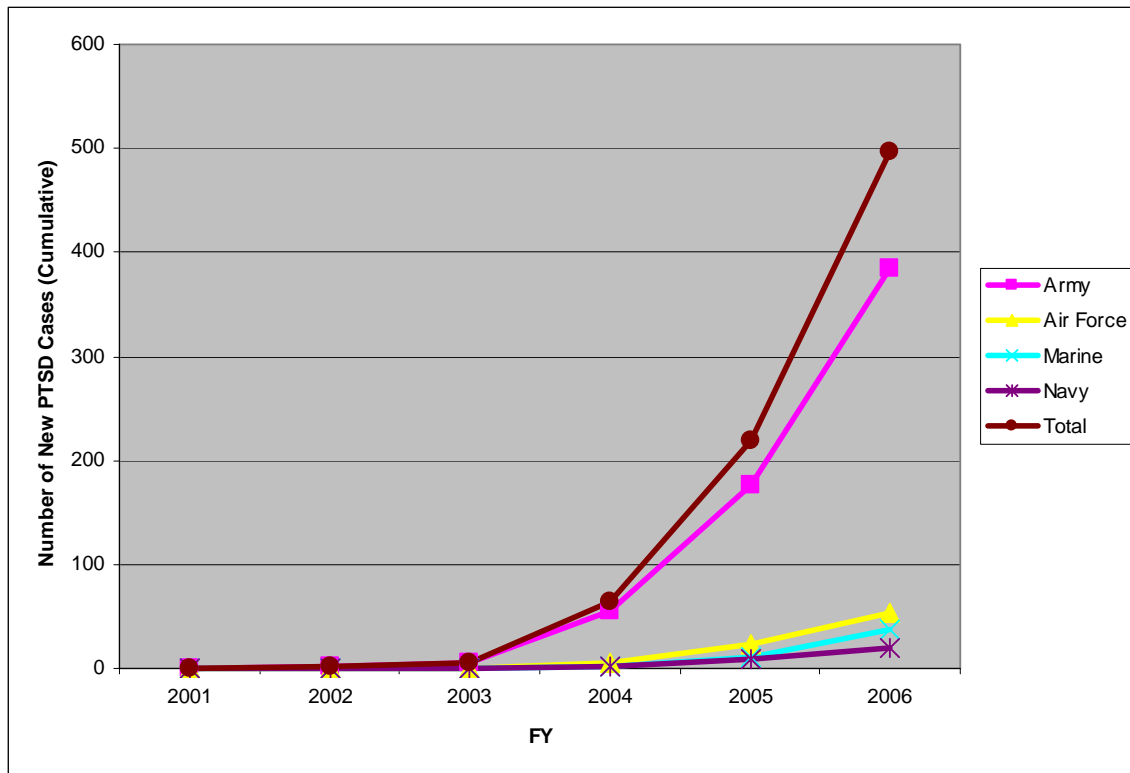


Figure 5.15. Cumulative Number of Active Duty TRICARE Beneficiaries (Officers and Warrant Officers) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD between FY2001 and FY2006

Figure 5.15 showed that the Army had the highest number of cumulative PTSD cases among the officer population. However, interestingly, Figure 5.16 shows that the Navy has the highest cumulative percentage of PTSD incidences among the officer population in the four services. To recap, the cumulative percentage of PTSD incidence refers to the percentage of the study population who has been diagnosed with PTSD up to the year of interest. Figure 5.16 shows that the cumulative percentage of PTSD incidence for the Navy officers was 1.6% in FY2006, i.e., 1.6% of the Navy officers who were ever deployed to Afghanistan and/or Iraq, had been diagnosed with PTSD between FY2001 to FY2006. The cumulative percentage of PTSD incidence for officers in the Army and Marine Corps was 1.5% and 1% respectively. Both the Army and Marine Corps have a higher number of cumulative PTSD cases compared to the Navy. The Army and Marine Corps have 384 and 38 cases respectively, compared to the 20 cases in the Navy. However, a larger number of officers in the Army and Marine Corps were ever deployed to Afghanistan and/or Iraq than the Navy. This resulted in a lower cumulative percentage of PTSD incidences for the Army and Marine Corps, compared to the Navy.

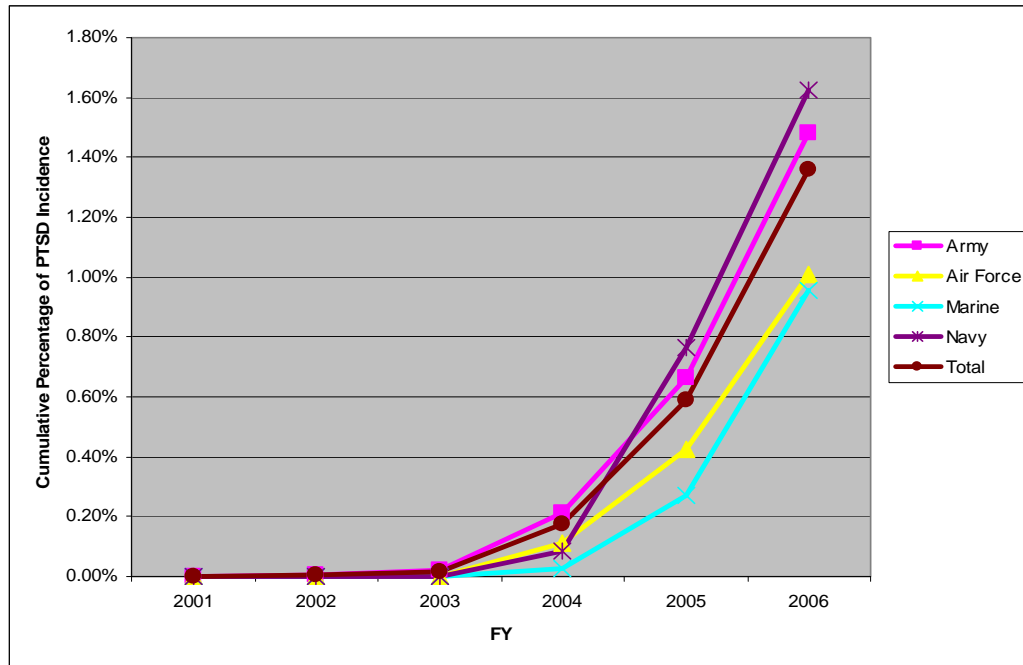


Figure 5.16. Cumulative Percentage of PTSD Incidence (Officers and Warrant Officers) Among Who Were Ever Deployed to Afghanistan and/or Iraq

In Section C1.3 of this chapter, it was noted that the cumulative percentage of PTSD incidence for the entire TRICARE officer enrollment in FY2006 was 0.7%. This cumulative percentage increased to 0.8% in Section C2.3 when the deployment histories of the officers were taken into consideration, and the study population was restricted to only officers who were ever deployed overseas. This section shows that the cumulative percentage has further increased to 1.4% when the study population was narrowed to include officers who were ever deployed to Afghanistan and/or Iraq. These percentage changes illustrate the upward effect of deployments to Afghanistan and/or Iraq on the probability of being diagnosed with PTSD for officers in the U.S. military.

3.4 Cumulative PTSD Incidence Rate Among All Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq

Figure 5.17 shows the cumulative number of PTSD cases among enlisted personnel who were ever deployed to Afghanistan and/or Iraq. Similar to the results of the officer population, the cumulative number of PTSD cases increased. In FY2006, the Army had the largest cumulative total of 7,867 PTSD cases among its enlisted personnel who were ever deployed to Afghanistan and/or Iraq. The cumulative number of PTSD cases for the Air Force, Marine Corps and Navy were 460, 1,283 and 401 respectively.

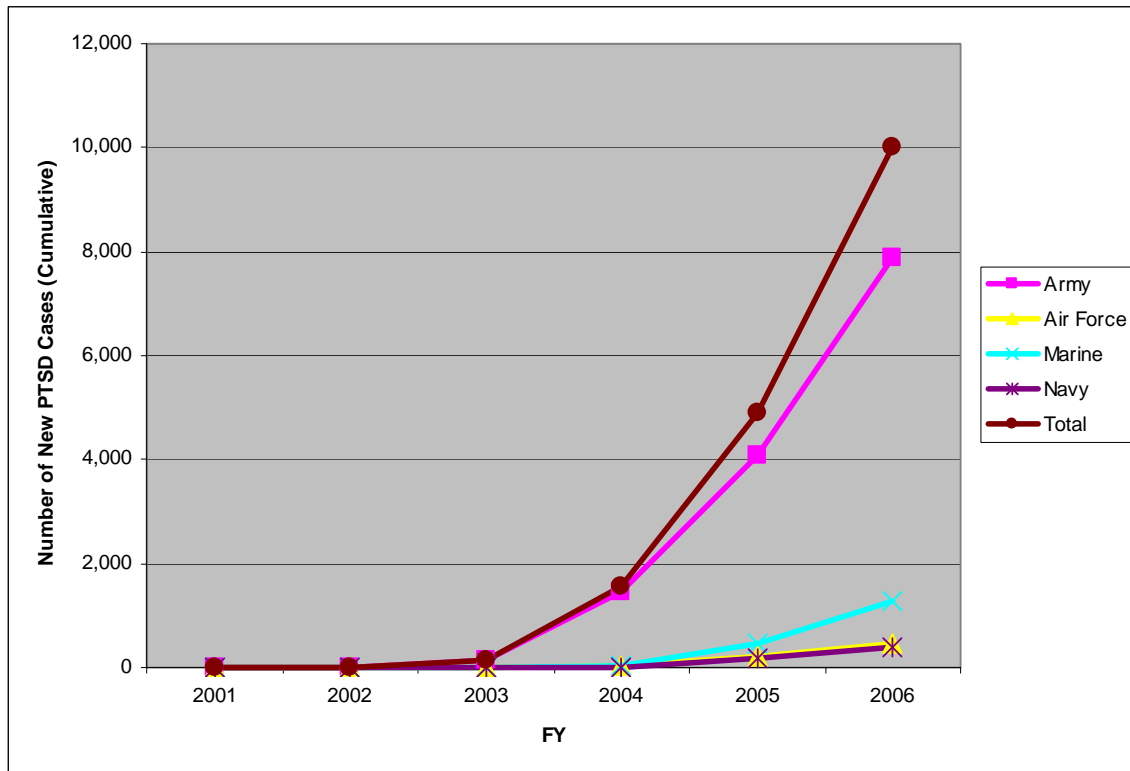


Figure 5.17. Cumulative Number of Active Duty TRICARE Beneficiaries (Enlisted Personnel) Who Were Ever Deployed to Afghanistan and/or Iraq, and Diagnosed with PTSD between FY2001 and FY2006

The analysis of the cumulative percentage of PTSD incidence across the different services' enlisted population yields similar outcomes as does the analysis of the officer population. The Navy has the highest cumulative

percentage of PTSD incidence (6.2%) among its enlisted personnel who were ever deployed to Afghanistan and/or Iraq, as seen in Figure 5.18. Although the enlisted personnel from the Army has the highest cumulative number of PTSD diagnosis counts from FY2001 to FY2006, the Army had a slightly lower cumulative percentage of 5.1% due to its larger number of enlisted personnel ever deployed to Afghanistan and/or Iraq. Enlisted personnel in the Air Force have the lowest cumulative percentage of 1.6%.

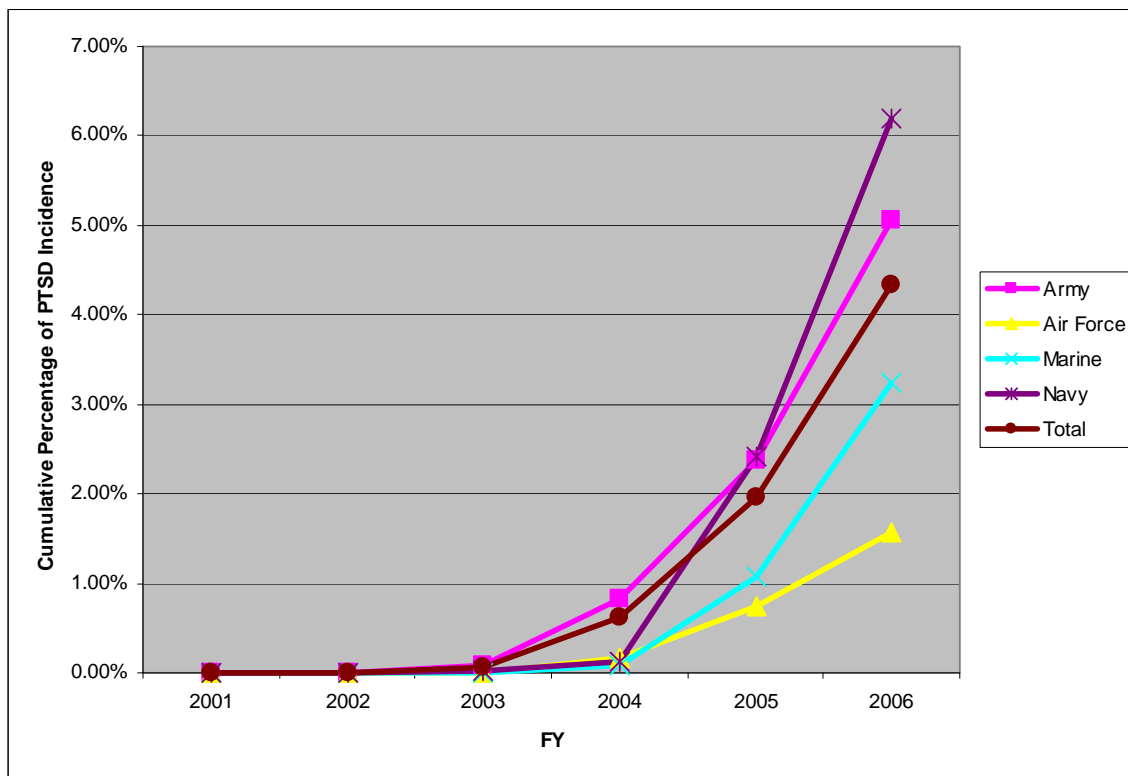


Figure 5.18. Cumulative Percentage of PTSD Incidence (Enlisted Personnel) Among Who Were Ever Deployed to Afghanistan and/or Iraq

Similar to the officer population's percentage, the cumulative percentage of PTSD incidence for the enlisted personnel increased when their deployment history was taken into consideration. The cumulative percentage for the entire TRICARE enrollment for enlisted personnel in FY2006 was 2%, as noted in Section C1.4 of this chapter. The cumulative percentage increased to 2.5% when the study population was narrowed to those ever deployed overseas. The cumulative percentage increased to 4.3% when the study population was further

restricted to those ever deployed to Afghanistan and/or Iraq. The magnitude in the percentage changes for the enlisted personnel was larger than those observed for the officers. This further suggests that the effect of deployments to Afghanistan and/or Iraq on the likelihood to develop PTSD may be more/is more significant on the enlisted personnel than the officers. This agrees with the findings in current literature. This thesis will further discuss the effect of deployments to Afghanistan and/or Iraq on officers and enlisted personnel based on results of the multivariate analyses in the next chapter.

4.1 Comparison of PTSD Incidence Across the Study Population

In order to facilitate the comparison of the trends in PTSD incidence across the four services and the three study populations, namely a) all active duty TRICARE enrollment, b) active duty personnel who were ever deployed overseas, and c) active duty personnel who were ever deployed to Afghanistan (AF) and/or Iraq (IZ), the number of new PTSD case diagnosed each year for the officer and enlisted population is summarized in Tables 5.9 and 5.10. The cumulative percentage of PTSD incidence, i.e., the percentage of the study population diagnosed with PTSD up the respective year of interest, based on the number of PTSD cases diagnosed between FY2001 to FY2006, for the officer and enlisted population is tabulated in Tables 5.11 and 5.12.

Number of New PTSD Cases Diagnosed Each Year for Officers and Warrant Officers												
	Army			Air Force			Marine Corp			Navy		
FY	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ
2001	86	0	0	51	0	0	9	0	0	47	0	0
2002	63	3	1	47	2	0	13	0	0	48	0	0
2003	86	12	4	57	6	0	13	3	0	34	5	0
2004	237	119	51	60	21	6	16	11	1	58	13	1
2005	394	263	120	80	33	17	33	23	10	62	23	8
2006	448	311	208	106	54	31	51	38	27	63	32	11
Total	1,314	708	384	401	116	54	135	75	38	312	73	20

Table 5.9. Number of New PTSD Case Diagnosed Each Year for Officers and Warrant Officers

Number of New PTSD Cases Diagnosed Each Year for Enlisted Personnel												
	Army			Air Force			Marine Corp			Navy		
FY	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ
2001	1,084	0	0	564	0	0	315	0	0	872	0	0
2002	976	23	9	481	30	0	257	3	0	727	31	9
2003	1,412	320	127	543	92	1	312	86	1	649	111	130
2004	3,731	2,241	1,328	633	183	49	604	378	6	822	253	1,414
2005	6,668	4,715	2,607	794	344	172	1,461	1,034	155	1,091	477	3,351
2006	7,116	5,332	3,796	1833	427	238	1,527	1,159	239	1,064	534	5,107
Total	20,987	12,631	7,867	3,848	1,076	460	4,476	2,660	401	5,225	1,406	20

Table 5.10. Number of New PTSD Case Diagnosed Each Year for Enlisted Personnel

Cumulative Percentage of PTSD Incidence (Based on PTSD Cases Diagnosed between FY2001 to FY2006) for Officers and Warrant Officers												
	Army			Air Force			Marine Corp			Navy		
FY	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ
2001	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0
2002	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0
2003	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0
2004	0.4	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.0	0.3	0.1	0.1
2005	0.7	0.7	0.7	0.3	0.2	0.4	0.4	0.3	0.3	0.4	0.2	0.8
2006	1.0	1.3	1.5	0.5	0.3	1.0	0.6	0.6	1.0	0.5	0.3	1.6

Table 5.11. Cumulative Percentage of PTSD Incidence for Officers and Warrant Officers

Cumulative Percentage of PTSD Incidence (Based on PTSD Cases Diagnosed between FY2001 to FY2006) for Enlisted Personnel												
	Army			Air Force			Marine Corp			Navy		
FY	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ	All	Overseas	AF/IZ
2001	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0
2002	0.3	0.0	0.0	0.3	0.0	0.0	0.3	0.0	0.0	0.4	0.0	0.0
2003	0.5	0.1	0.1	0.4	0.1	0.0	0.4	0.1	0.0	0.6	0.2	0.0
2004	0.9	0.8	0.8	0.6	0.2	0.2	0.7	0.4	0.1	0.8	0.2	0.1
2005	1.8	2.5	2.4	0.8	0.4	0.7	1.4	1.5	1.1	1.1	0.4	2.4
2006	2.8	4.7	5.1	1.1	0.7	1.6	2.1	3.0	3.3	1.4	0.8	6.2

Table 5.12. Cumulative Percentage of PTSD Incidence for Enlisted Personnel

A significant increase in the number of new PTSD cases diagnosed per year among both the officers and enlisted personnel can be easily observed across all three study populations from Tables 5.9 and 5.10, particularly from FY2004 onwards. The cumulative percentages of PTSD incidence shown in Tables 5.11 and 5.12 are computed based on the number of new PTSD cases between FY2001 and FY2006, as well as the size of the study population. These percentages show that among the three study populations, personnel who were ever deployed to Afghanistan and/or Iraq have the largest percentage increase in the number of new PTSD cases. This suggests that overseas deployments, particularly deployments to Afghanistan and Iraq, were a significant cause for the rising number of new PTSD cases diagnosed per year during the study period.

D. SUMMARY

The prolonged duration of OIF and OEF seemed to have exacerbated the toll on those deployed to Afghanistan and Iraq, as the statistics for PTSD continue to climb across all services. The DEERS data from TRICARE has provided a

more comprehensive insight into the rising PTSD incidence trends across the four services of the U.S military between FY2001 to FY2006.

The trend analyses across the three different study populations took into consideration the deployment history of the TRICARE beneficiaries, and showed that personnel deployed to Afghanistan and/or Iraq were more susceptible to PTSD risks. The trend analyses suggest that sailors deployed to Afghanistan and/or Iraq may be equally susceptible to PTSD risks as the soldiers and marines deployed. In addition, the enlisted population appeared to be more susceptible to PTSD risks, compared to the officers.

The biggest surprise arising from the information in this chapter is perhaps the low percentage of overall studied population diagnosed with PTSD, compared to the findings in current literature. Current literature has found that, at least among the Army and Marine Corps, the prevalence of PTSD is about 11-18%. It is important to keep in mind the differences between this thesis and the prevailing literature. First, this thesis only examines the active duty members who were enrolled in the TRICARE health care system from FY2001 to FY2006. Personnel who have suffered combat-related injuries and were rendered unfit for active duty, would have been transferred to the VA system. These personnel would not be captured in the DEERS data provided by TRICARE.

Secondly, this thesis uses clinical data from TRICARE, while prevailing literature had relied primarily on survey research on a selected group. Due to the stigma associated with mental health illness, it is not surprising that few people will come forth and seek treatment for PTSD, especially while they are still on active duty.

Thirdly, the full sample was comprised of all active duty service insured by TRICARE, regardless of whether they have ever been deployed overseas. The sub-sample analysis (especially the analysis on personnel ever deployed to Afghanistan and/or Iraq) shows a higher rate of PTSD incidence, and is consistent with the expectations of the authors.

Since the rising trends of PTSD incidence across the different service branches of the U.S military between FY2001 to FY2006 have been established, it would be appropriate to evaluate the impact of deployment intensity (deployment location and duration) on the probability of being diagnosed with PTSD among deployed active duty personnel. The results of these multivariate analyses will be discussed in the next chapter.

THIS PAGE INTENTIONALLY LEFT BLANK

VI. RESULTS OF ANALYSIS: EFFECT OF DEPLOYMENT INTENSITY ON PROBABILITY OF BEING DIAGNOSED WITH PTSD

A. OVERVIEW

This chapter will discuss the results of the various probit models used to estimate the effects of deployment intensity on the probability of being diagnosed with PTSD. Separate analyses were conducted for the four services of the U.S military. In addition, separate analyses were performed for officers and enlisted personnel. These results were compared to examine how the effects of deployment intensity differ across these eight different study populations.

A total of four probit models were used for each of the study populations. Besides a set of service and demographics characteristics such as rank, gender, race, marital status and age that was kept constant across the four models, a different set of key variables of interest was used in each of the models to estimate the various effects of deployment intensity. A review of the four probit models is provided below.

1. Model 1: Effect of Last Deployment Location

The first model estimates the effect of the last deployment location on the probability of being diagnosed with PTSD. The last deployment refers to the most recently completed deployment prior to the PTSD diagnosis date for the PTSD population and the date of DEERS observation for the non-PTSD population respectively. This model also examines the difference in the effect (if any) of a shore or shipboard deployment for a sailor.

2. Model 2: Interactive Effect of Last Deployment Location and Duration

The second model estimates the effect of the last deployment location and its duration on the probability of being diagnosed with PTSD. The model also uses interactive terms of the last deployment location and duration to determine whether the effect of deployment duration was exacerbated or mitigated by the deployment location.

3. Model 3: Effect of Deployment Location History

The third model considers all the deployments (between FY2001 to FY2006) that have occurred prior to the PTSD diagnosis date or date of DEERS observation in the individual's deployment history, and estimates the effect of being ever deployed to the respective locations on the probability of being diagnosed with PTSD. Deployments that occurred after the PTSD diagnosis date or date of observations were excluded from the analysis. The model also incorporates the effect of the nature of the deployment (ashore or afloat) for the sailors.

4. Model 4: Effect of Single and Multiple Deployments to the Same Location

The fourth model looks at the effect of single and multiple deployments to various deployment locations on the probability of being diagnosed with PTSD. All deployments that occurred between FY2001 to FY2006 and prior to the PTSD diagnosis date or date of observation were included in the analysis. In addition, the model also examines the effect of single and multiple shore deployments for the sailors.

The rest of this chapter will be organized as follows: Section B will provide a descriptive analysis of the sample for the multivariate analysis. Sections C, D,

E and F will present and discuss the results of the multivariate analyses from the four probit models, respectively. Section G will provide a summary of the chapter.

B. DESCRIPTIVE STATISTICS OF SAMPLE FOR MULTIVARIATE ANALYSIS

The original DEERS dataset is comprised of 3,353,689 and 36,698 unique EDIPN observations for the non-PTSD and PTSD populations, respectively (after excluding DEERS observations with missing values). These DEERS observations contain the demographic information (gender, race, military rank/paygrade and marital status, etc.) of active duty personnel from all four services of the U.S. military. However, due to the sensitivity of the detailed deployment information on the military personnel, only the corresponding CTS deployment data for the PTSD population and a 20% random sample of the non-PTSD population was made available for our multivariate analyses. The sample for the multivariate analyses thus consisted of 740,772 and 35,355 unique EDIPN observations for the non-PTSD and PTSD samples, respectively (after excluding CTS observations with missing values).

It was essential to validate the sampling design and processes used in the random sampling of the non-PTSD observations. Verifying that the random non-PTSD sample for the multivariate analyses was representative of the non-PTSD population in the original DEERS dataset allowed the results of the multivariate analyses derived from the sample to be generalized for the entire DEERS population. The descriptive statistics of the regression sample's demographic characteristics can be compared against those of the original DEERS dataset (depicted in Tables 5.1 and 5.2) to establish whether the regression sample was representative of the DEERS population.

1. Officers and Warrant Officer Population

Table 6.1 shows the descriptive statistics for the demographic characteristics from the DEERS data and the deployment characteristics (deployment location and duration, MOS, etc.) from the CTS data for the officer

population in the regression sample. The distribution of the demographic characteristics for the random non-PTSD officer sample in Table 6.1 was compared against those for the non-PTSD officer population in Table 5.1. The distributions of the demographic characteristics (gender, marital status, race and age) for the regression sample and the original DEERS dataset were found to be similar. The differences in the distributions of the three demographic characteristics (gender, marital status and race) were 5% or less, across the non-PTSD and PTSD samples for all four services. For instance, 15.5% of the officers in the Army's non-PTSD population (Table 5.1) are females, while 11.6% of the Army's random non-PTSD sample are females. In addition, the differences in the average age for the original DEERS observations and the regression sample was one year or less. These factors indicate that the sampling design was valid and the regression sample was representative of the original DEERS dataset for the officers.

Since the regression sample is representative of the original DEERS dataset, similar observations pertaining to demographic characteristics were made from Table 5.1 and Table 6.1. Table 6.1 suggests that a disproportionately larger percentage of females were diagnosed with PTSD across the four services, particularly in the Air Force and Navy. In the Air Force, females constituted only 14% of the non-PTSD sample, but they constituted 52% of the PTSD sample. Table 6.1 also suggests married officers (except for the Air Force) may be more likely to be diagnosed with PTSD compared to the singles, no particular race appeared to be significantly more or less vulnerable to PTSD.

Similar to the original DEERS dataset, the average age of the PTSD sample was higher than the average age for the non-PTSD sample across all four services. This suggests that PTSD risks may be positively correlated with age since an older officer is likely to have experienced more deployments, and hence potentially greater exposure to the violent conditions in the war zones, compared to a younger officer.

Besides the demographic characteristics, Table 6.1 also tabulates the deployment characteristics for the officer sample. This includes the distribution of the last deployment location, its type (ashore or shipboard) and duration, deployment location history, frequency of deployment, and MOS. Several observations were made from the descriptive statistics of these deployment characteristics in Table 6.1.

In this thesis, the last deployment of the service members referred to the most recent completed deployment prior to the PTSD diagnosis date for the PTSD population and date of DEERS observation for the non-PTSD population respectively. Table 6.1 shows that approximately 25% of the officers in the PTSD sample for the Army and Marine Corps were last deployed to Afghanistan or Iraq, while a lower percentage of 14% and 7% were observed deployed to Afghanistan or Iraq for the Air Force and Navy respectively. Table 6.1 also shows that the PTSD sample for all services had a disproportionately high percentage of officers whose last deployment location was Iraq, compared to the respective non-PTSD sample. For instance, 23% of the PTSD sample in the Army had their last deployment to Iraq, but only 8% of the non-PTSD sample was last deployed to Iraq. This suggests that officers, whose last deployment location was Iraq, have a disproportionately higher probability of being diagnosed with PTSD.

The increase in PTSD risk due to deployments in Iraq was also inferred from the descriptive statistics on the past deployment location history. Table 6.1 shows that there is a disproportionately high percentage of service members who were ever deployed to Iraq in the PTSD sample for all services, compared to the non-PTSD sample. For instance, only 8% of the non-PTSD sample in the Marine Corps was ever deployed to Iraq prior to their PTSD diagnosis date or date of DEERS observations, while 26% of the PTSD sample was ever deployed to Iraq.

	Officers and Warrant Officers									
	Army		Air Force		Marine Corps		Navy		Total	
	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD
Sample Size	48,988		22,618		8,933		15,540		96,079	
Number of observations	47,715	1,273	22,228	390	8,799	134	15,246	294	93,988	2,091
% of observations for respective service	97.4%	2.6%	98.3%	1.7%	98.5%	1.5%	98.1%	1.9%	97.8%	2.2%
Location of Last Deployment Prior to PTSD Diagnosis or DEERS Extraction Date										
Afghanistan	3.1%	4.2%	1.2%	1.0%	0.9%	1.5%	0.5%	0.3%	2.0%	2.9%
Iraq	7.9%	22.6%	3.4%	12.8%	8.2%	23.9%	1.0%	6.5%	5.8%	18.6%
Other Middle East countries	10.7%	24.4%	17.8%	9.5%	12.8%	20.9%	8.3%	10.2%	12.2%	19.4%
Other countries	4.3%	4.4%	15.1%	6.4%	7.7%	9.7%	23.8%	7.8%	10.3%	5.6%
No overseas deployment	74.0%	44.4%	62.5%	70.3%	70.4%	44.0%	66.3%	75.2%	69.7%	53.5%
Last Deployment Prior to PTSD Diagnosis or DEERS Extraction Date was:										
Onboard ship	-	-	-	-	-	-	6.7%	11.9%	-	-
On shore	-	-	-	-	-	-	27.0%	12.9%	-	-
No overseas deployment	-	-	-	-	-	-	66.3%	75.2%	-	-
Duration of Last Deployment Prior to PTSD Diagnosis or DEERS Extraction Date										
Short	13.2%	20.5%	18.2%	6.9%	16.9%	31.3%	14.0%	7.1%	14.9%	16.8%
Medium	4.9%	11.4%	13.8%	15.6%	9.6%	19.4%	7.0%	6.5%	7.8%	12.0%
Long	7.9%	23.7%	5.4%	7.2%	3.1%	5.2%	12.6%	11.2%	7.6%	17.7%
Have ever been Deployed to the Following Country / Region Prior to PTSD Diagnosis or DEERS Extraction Date										
Afghanistan	3.9%	5.7%	1.6%	1.3%	1.1%	2.2%	0.6%	0.7%	2.5%	4.0%
Iraq	8.5%	25.8%	3.7%	12.8%	8.4%	26.1%	1.1%	6.5%	6.2%	20.7%
Other Middle East Countries	14.4%	38.4%	20.7%	12.3%	16.0%	32.1%	9.0%	10.9%	15.2%	29.3%
Other Countries	5.2%	7.5%	18.1%	9.0%	10.0%	17.9%	24.8%	9.2%	11.9%	8.7%
No overseas deployment	74.0%	44.4%	62.5%	70.3%	70.4%	44.0%	66.3%	75.2%	69.7%	53.5%
Number of Deployment Prior to PTSD Diagnosis or DEERS Extraction Date										
Once only	18.3%	32.1%	24.1%	21.3%	21.6%	29.1%	25.7%	20.7%	21.2%	28.3%
More than once	7.7%	23.6%	13.4%	8.5%	8.0%	26.9%	8.0%	4.1%	9.1%	18.2%
No overseas deployment	74.0%	44.4%	62.5%	70.3%	70.4%	44.0%	66.3%	75.2%	69.7%	53.5%

	Officers and Warrant Officers									
	Army		Air Force		Marine Corps		Navy		Total	
	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD
Sample Size	48,988		22,618		8,933		15,540		96,079	
Number of observations	47,715	1,273	22,228	390	8,799	134	15,246	294	93,988	2,091
% of observations for respective service	97.4%	2.6%	98.3%	1.7%	98.5%	1.5%	98.1%	1.9%	97.8%	2.2%
MOS*										
Combat Arms	29.2%	16.5%	0.4%	0.0%	28.0%	16.4%	0.9%	0.0%	17.7%	11.1%
Combat Support	15.8%	10.9%	0.2%	0.0%	8.3%	6.7%	11.0%	2.7%	10.6%	7.5%
Combat Service Support	19.9%	14.3%	1.2%	0.5%	29.1%	24.6%	85.6%	36.7%	27.0%	15.5%
Aviation	-	-	-	-	30.6%	18.7%	-	-	2.9%	1.2%
Medical	11.1%	11.7%	-	-	-	-	-	-	5.6%	7.1%
Other MOS	24.0%	46.6%	98.2%	99.5%	4.0%	33.6%	2.5%	60.5%	36.2%	57.6%
Sex										
Female	11.6%	26.9%	13.8%	51.5%	5.3%	14.2%	11.3%	41.8%	11.5%	32.8%
Male	88.4%	73.1%	86.2%	48.5%	94.7%	85.8%	88.7%	58.2%	88.5%	67.2%
Marital Status										
Single	32.2%	28.2%	31.4%	36.2%	34.6%	27.6%	39.7%	36.1%	33.5%	30.8%
Married	67.8%	71.8%	68.6%	63.8%	65.4%	72.4%	60.3%	63.9%	66.5%	69.2%
Race										
White	77.4%	72.5%	85.2%	77.9%	82.8%	88.1%	81.8%	79.9%	80.5%	75.6%
Black	11.5%	14.5%	5.3%	9.0%	6.1%	4.5%	7.8%	5.8%	8.9%	11.6%
Hispanic	2.7%	4.0%	1.7%	3.6%	2.8%	3.0%	4.2%	5.8%	2.7%	4.1%
Asian	3.7%	2.5%	2.0%	1.8%	2.0%	0.7%	3.8%	4.8%	3.2%	2.6%
Other races	4.7%	6.5%	5.8%	7.7%	6.3%	3.7%	2.4%	3.7%	4.7%	6.2%
Age at Last Deployment Prior to PTSD										
Diagnosis or DEERS Extraction Date										
Mean age (years)	35.0	38.9	34.4	37.5	33.3	36.7	34.2	37.9	34.5	38.4
* Air Force: Medical is combined with Other MOS due to small sample size in Medical MOS										
*Navy: Medical and Aviation are combined with Other MOS due to small sample size in Medical and Aviation										

Table 6.1. Descriptive Statistics of Sample for Multivariate Analyses (Officers and Warrant Officers)

On the other hand, officers whose last deployment was shore-based constituted 27% of the non-PTSD sample, while only 13% of the PTSD sample had a last shore-based deployment. We had hypothesized that sailors on shore deployment were expected to be more likely to be diagnosed with PTSD, compared to sailors deployed on ships, as the former were likely to face higher threats. The effect of the last deployment location type on the probability of being diagnosed with PTSD is further examined in the first probit model.

Table 6.1 also suggests that as the duration of the last deployment increased, the probability of being diagnosed with PTSD increased too. All deployments were categorized as a short, medium or long deployment based on their duration. As the distribution of the deployment duration differs between service branches, the interval definition for short, medium or long deployment was determined by the distribution of the deployment duration in the empirical data, and thus varied between the service branches. The interval definition for the services was tabulated in Table 4.1. The PTSD sample for all services, except for the Navy, had a higher percentage of officers whose last deployment was categorized as medium or long, compared to the non-PTSD sample. For example, for the Army, 35% of its PTSD sample had a last deployment that was categorized as medium or long, while only 12% in its non-PTSD sample had a medium or long deployment.

The descriptive statistics of the MOS categories suggests that service members in the combat support and combat service support arms had a lower probability of being diagnosed with PTSD compared to the other MOS categories. Officers in the combat support and combat service support arms constituted a larger percentage of the non-PTSD sample across the services, compared to the PTSD sample.

The marginal effects of these deployment characteristics are further analyzed in the multivariate analyses in the subsequent sections of this chapter.

2. Enlisted Population

Table 6.2 shows the descriptive statistics of the enlisted population for the regression sample. A comparison of Table 6.2 against Table 5.2 suggests that the regression sample for the enlisted personnel was also representative of the enlisted population in the original DEERS dataset. The differences in the distributions of the three demographic characteristics (gender, marital status and race) were 5.9% or less across the non-PTSD and PTSD samples, and the differences in the average age for the original DEERS observations and the regression sample were 0.2 years or less, for across all four services.

Similar observations were drawn from the descriptive statistics of the officer sample and enlisted personnel sample. Similar to the officer sample, a larger percentage of the PTSD enlisted personnel sample in the Army and Marine Corps was last deployed to Afghanistan and/or Iraq, compared to the Air Force and Navy. There was a higher percentage of enlisted personnel whose last deployment location was Iraq in the PTSD sample, compared to the non-PTSD sample for all services too. Service members from all services who were ever deployed to Iraq also constituted a larger percentage in the PTSD sample, compared to the non-PTSD sample. These indicate that the deployments to Iraq increased the probability of being diagnosed with PTSD for both the officers and enlisted personnel across all services.

Enlisted personnel who were last deployed ashore also appeared to have a lower probability of being diagnosed with PTSD, compared to the enlisted personnel who were last deployed onboard ships. Similar to the officer sample, this contradicts our hypothesis.

The duration of the last deployment also appeared to be positively correlated with the probability of being diagnosed for the enlisted personnel in the Army and Marine Corps. There was a larger percentage of enlisted personnel with a last deployment that was categorized as medium or long in their PTSD sample, compared to the non-PTSD sample.

Finally, Table 6.2 also suggests that enlisted personnel in the combat support and combat service support arms may have a lower probability of being diagnosed with PTSD compared to the other MOS categories. Similar to the officers, enlisted personnel in the combat support and combat service support arms constituted a larger percentage of the non-PTSD sample across the services, compared to the PTSD sample.

	Enlisted									
	Army		Air Force		Marine Corps		Navy		Total	
	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD
Sample Size	333,766		113,006		98,932		134,704		680,408	
Number of observations	313,489	20,277	109,278	3,728	94,491	4,441	129,526	5,178	646,784	33,624
% of observations for respective service	93.9%	6.1%	96.7%	3.3%	95.5%	4.5%	96.2%	3.8%	95.1%	4.9%
Location of Last Deployment Prior to PTSD Diagnosis or DEERS Extraction Date										
Afghanistan	2.2%	3.3%	1.0%	0.9%	0.9%	1.5%	0.2%	0.7%	1.4%	2.4%
Iraq	8.7%	31.0%	4.4%	11.0%	7.5%	25.6%	0.8%	7.0%	6.2%	24.4%
Other Middle East countries	8.0%	24.0%	18.9%	10.6%	10.1%	23.8%	6.0%	10.1%	9.7%	20.3%
Other countries	2.4%	3.9%	14.3%	6.4%	5.7%	9.1%	28.7%	9.4%	10.2%	5.7%
No overseas deployment	78.7%	37.7%	61.5%	71.1%	75.8%	40.1%	64.3%	72.8%	72.5%	47.1%
Last Deployment Prior to PTSD Diagnosis or DEERS Extraction Date was:										
Onboard ship	-	-	-	-	-	-	9.2%	18.8%	-	-
On shore	-	-	-	-	-	-	26.5%	8.4%	-	-
No overseas deployment	-	-	-	-	-	-	64.3%	72.8%	-	-
Duration of Last Deployment Prior to PTSD Diagnosis or DEERS Extraction Date										
Short	9.0%	19.9%	13.4%	5.6%	12.5%	25.8%	11.2%	6.5%	10.7%	17.0%
Medium	4.2%	11.0%	18.3%	14.5%	10.1%	30.7%	8.3%	6.3%	8.3%	13.3%
Long	8.0%	31.4%	6.8%	8.8%	1.5%	3.4%	16.2%	14.4%	8.5%	22.6%
Have ever been Deployed to the Following Country / Region Prior to PTSD Diagnosis or DEERS Extraction Date										
Afghanistan	2.7%	5.1%	1.2%	1.0%	1.0%	1.9%	0.2%	0.9%	1.7%	3.6%
Iraq	9.4%	35.4%	4.7%	11.5%	7.7%	27.4%	0.8%	7.0%	6.6%	27.3%
Other Middle East Countries	12.1%	43.1%	21.8%	14.6%	12.2%	33.9%	6.6%	12.1%	12.6%	33.9%
Other Countries	3.0%	5.6%	16.5%	9.0%	7.4%	15.2%	29.2%	10.7%	11.2%	8.1%
No overseas deployment	78.7%	37.7%	61.5%	71.1%	75.8%	40.1%	64.3%	72.8%	72.5%	47.1%
Number of Deployment Prior to PTSD Diagnosis or DEERS Extraction Date										
Once only	14.6%	34.9%	27.6%	19.3%	18.9%	35.2%	28.1%	20.5%	20.1%	31.0%
More than once	6.7%	27.4%	10.9%	9.6%	5.3%	24.7%	7.6%	6.6%	7.4%	21.8%
No overseas deployment	78.7%	37.7%	61.5%	71.1%	75.8%	40.1%	64.3%	72.8%	72.5%	47.1%

	Enlisted									
	Army		Air Force		Marine Corps		Navy		Total	
	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD	Non-PTSD	PTSD
Sample Size	333,766		113,006		98,932		134,704		680,408	
Number of observations	313,489	20,277	109,278	3,728	94,491	4,441	129,526	5,178	646,784	33,624
% of observations for respective service	93.9%	6.1%	96.7%	3.3%	95.5%	4.5%	96.2%	3.8%	95.1%	4.9%
MOS*										
Combat Arms	29.3%	25.1%	10.7%	3.8%	38.6%	33.8%	4.8%	1.2%	22.6%	20.2%
Combat Support	11.0%	6.0%	0.2%	0.0%	16.8%	10.4%	9.6%	1.7%	9.7%	5.2%
Combat Service Support	26.8%	20.0%	79.2%	31.3%	28.0%	20.0%	5.7%	1.9%	31.6%	18.4%
Aviation	-	-	-	-	15.1%	6.0%	3.4%	0.7%	2.9%	0.9%
Medical	10.3%	6.4%	-	-	-	-	-	-	5.0%	3.9%
Other MOS	22.6%	42.5%	9.8%	64.9%	1.3%	29.9%	76.5%	94.5%	28.1%	51.3%
Sex										
Female	11.3%	19.1%	15.7%	53.5%	3.6%	12.6%	12.5%	41.5%	11.2%	25.5%
Male	88.7%	80.9%	84.3%	46.5%	96.4%	87.4%	87.5%	58.5%	88.8%	74.5%
Marital Status										
Single	53.9%	38.4%	48.2%	49.0%	69.6%	51.4%	55.1%	54.5%	55.5%	43.8%
Married	46.1%	61.6%	51.8%	51.0%	30.4%	48.6%	44.9%	45.5%	44.5%	56.2%
Race										
White	63.6%	65.4%	74.0%	73.1%	71.2%	71.6%	57.0%	62.6%	65.2%	66.7%
Black	19.7%	19.1%	15.3%	15.7%	10.3%	9.9%	21.7%	16.7%	18.0%	17.1%
Hispanic	6.9%	5.9%	3.4%	3.8%	8.2%	8.4%	7.2%	7.4%	6.6%	6.2%
Asian	3.9%	2.5%	2.2%	1.4%	2.8%	2.2%	6.0%	3.8%	3.9%	2.5%
Other races	5.9%	7.1%	5.0%	6.0%	7.6%	7.9%	8.0%	9.4%	6.4%	7.4%
Age at Last Deployment Prior to PTSD										
Diagnosis or DEERS Extraction Date										
Mean age (years)	27.4	29.6	28.5	27.7	23.3	24.6	27.0	26.9	26.9	28.4
* Air Force and Navy: Medical is combined with Other MOS due to small sample size in Medical MOS										

Table 6.2. Descriptive Statistics of Sample for Multivariate Analyses (Enlisted Personnel)

C. RESULTS OF MULTIVARIATE ANALYSIS MODEL 1 – EFFECT OF LAST DEPLOYMENT LOCATION

The first multivariate probit model estimated the effect of the last deployment location on the probability of being diagnosed with PTSD. This model also examined the difference in the effect (if any) of a shore or shipboard deployment for a sailor. The dependent variable was a binary variable which captured whether a service member was diagnosed with PTSD. The key variables of interest for the first model were the last deployment location and its location type. In addition, this model, as well as the remaining three models, also included a set of control variables for the service and demographic characteristics of the sample.

Due to data restriction, only a random 20% sample of the non-PTSD observations in the original DEERS dataset was available for the multivariate analyses. In order to account for the sampling, weights were assigned to the observations in the sample for the multivariate analyses. The assigned weights varied across the four service branches and reflected the different sampling ratios⁴⁴ among the four services, as well as between the officer and enlisted personnel populations. These weights were kept constant across the four probit models.

1. Officers and Warrant Officers

Table 6.3 shows the result of the first probit model for the officers and warrant officers across the services. It shows that the effect of the last deployment on the probability of being diagnosed with PTSD was dependent on the location of the deployment, and differed across the services. The effect of the last deployment location for the four services is described below.

⁴⁴ The sampling ratio was defined as the ratio of the number of unique EDIPNs in the sample for the multivariate analyses, to the number of unique EDIPNs in the original DEERS dataset for the respective study population.

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Last Deployment Location and Location Type				
Afghanistan	0.004*** (0.001)	-0.001 (0.001)	0.006 (0.005)	-
Iraq	0.013*** (0.001)	0.003*** (0.001)	0.008*** (0.002)	-
Other Middle East Countries	0.009*** (0.001)	-0.001*** (0.000)	0.004*** (0.001)	-
Other Countries	0.001* (0.001)	-0.001*** -0.001	0.003* (0.002)	-
Shore Deployment in Afghanistan	-	-	-	-0.000* (0.000)
Shore Deployment in Iraq	-	-	-	0.003 (0.002)
Shipboard Deployment in Afghanistan or Iraq	-	-	-	0.001 (0.001)
Shore Deployment in Other Middle East Countries	-	-	-	-0.000* (0.000)
Shipboard Deployment in Other Middle East Countries	-	-	-	0.002* (0.001)
Shore Deployment in Other Countries	-	-	-	-0.001*** (0.000)
Shipboard Deployment in Other Countries	-	-	-	0.000 (0.000)
Military Occupation Codes				
Combat Support	0.000 (0.000)	-	-0.000 (0.001)	0.401** (0.164)
Combat Service Support	-0.000 (0.000)	-	0.000 (0.001)	0.002*** (0.001)
Aviation	-	-	-0.000 (0.001)	-
Medical	0.000 (0.000)	-	-	-
Other MOS	0.007*** (0.001)	-	0.089*** (0.024)	0.980*** (0.017)
Paygrade				
O1 to O2	0.003*** (0.001)	-	-0.001* (0.001)	0.002 (0.001)
O3	0.003*** (0.001)	0.000 (0.000)	-0.001* (0.000)	0.006* (0.003)
O4	0.001 (0.000)	-0.001* (0.000)	-0.002*** (0.000)	0.005 (0.003)

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
O5	0.000 (0.001)	-0.000 (0.000)	-0.002*** (0.000)	0.003 (0.003)
O6 to O10	-0.001 (0.001)	-0.001 (0.000)	-0.002*** (0.000)	0.003 (0.003)
Demographics				
Black	0.001* (0.000)	0.000 (0.000)	-0.001*** (0.000)	-0.000 (0.000)
Hispanic	0.003** (0.001)	0.002* (0.001)	-0.001 (0.001)	0.000 (0.000)
Asian	-0.001* (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.000 (0.000)
Other Races	0.002*** (0.001)	0.001 (0.001)	-0.001 (0.001)	0.000 (0.000)
Female	0.009*** (0.001)	0.008*** (0.001)	0.004** (0.002)	0.001*** (0.000)
Single	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Fiscal Year of Observation				
FY2002	-0.001*** (0.001)	0.000 (0.000)	0.001 (0.001)	0.000 (0.000)
FY2003	-0.002*** (0.000)	0.001 (0.001)	-0.000 (0.001)	-0.000 (0.000)
FY2004	-0.000 (0.001)	0.001 (0.001)	0.000 (0.001)	0.001** (0.000)
FY2005	0.001* (0.001)	0.001* (0.001)	0.001 (0.001)	0.000 (0.000)
FY2006	0.001 (0.001)	0.002** (0.001)	0.002 (0.002)	0.000 (0.000)
Observations	48952	22593	8927	15518
Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.3. Marginal Effect of Last Deployment Location and Type on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers)

a. Army

The coefficient estimates for Afghanistan, Iraq and other Middle East countries were statistically significant at the 0.01 level. The average Army officer's probability of being diagnosed with PTSD increased by 0.004 or

0.013 if he was last deployed to Afghanistan or Iraq respectively, compared to those not deployed overseas. The probability of being diagnosed with PTSD also increased by 0.009 if he was last deployed to other Middle East countries, *ceteris paribus*.

b. Air Force

The coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.01 level. The average Air Force officer's probability of being diagnosed with PTSD increased by 0.003 if he was last deployed to Iraq. However, the magnitude of the coefficient estimate for Iraq was smaller than those observed for the Army or Marine Corps. This finding is consistent with our hypothesis that the exposure to threats and violent conditions in war-zones increases significantly for officers in the Army or Marine Corps who were deployed overseas on ground missions, compared to officers who were not deployed overseas. For the Air Force, the differential in exposure to threats and violent conditions between officers who were deployed overseas and those who were not deployed overseas was expected to be smaller due to their deployment and mission profiles in modern aerial warfare. Hence, the differential in the probability of being diagnosed with PTSD due to overseas deployments was expected to be smaller for the Air Force officers, compared to those in the Army or Marine Corps.

c. Marine Corps

For officers in the Marine Corps, the coefficient estimates for Iraq and other Middle East countries were statistically significant at the 0.01 level. For an average officer in the Marine Corps, his probability of being diagnosed with PTSD increased by 0.008 if he was last deployed to Iraq. The coefficient estimate for Afghanistan was however not statistically significant at the 0.05 level.

d. Navy

The coefficient estimate for shore deployment in other countries was the only statistically significant estimate at the 0.05 level, and its magnitude was small at -0.1 percentage point. This indicates that there was no significant difference in the probability of being diagnosed with PTSD for a Navy officer who was last deployed overseas, compared to those with no overseas deployment. Similar to the Air Force, this could be due to the small differential increase in exposure to the violent conditions or threats in war-zones between a Navy officer who was last deployed overseas, compared to an officer who was not deployed, due to the mission profile in modern naval warfare. In addition, there was no significant difference between the effect of a shore or shipboard deployment on the probability of being diagnosed with PTSD for the officers.

Table 6.3 shows that officers from the Army, Air Force and Marine Corps had the largest increase in their probability of being diagnosed with PTSD if they were last deployed to Iraq. This is consistent with the analysis of the descriptive statistics in Table 6.1. The descriptive statistics have suggested that officers, whose last deployment location was Iraq, had a disproportional higher risk of being diagnosed with PTSD.

Among the last deployment location coefficient estimates that were statistically significant, the Army's coefficient estimate for deployment to Iraq had the largest magnitude of 1.3 percentage point. The small magnitudes of these coefficient estimates understate the effect of the last deployment location on the probability of being diagnosed with PTSD. We conducted an alternate analysis for Army officers using a logit multivariate model with the same model specification as the probit model, i.e. the logit model contained the same independent and dependent variables, and sampling weights as the probit model.

Similar to the probit model, the logit model is a nonlinear binary response model and the value of the dependent variable is restricted to between zero and one. The probit model was preferred for this thesis, as it is

generally easier to interpret the results of a probit model, compared to that of a logit model. However, due to the small magnitudes of the coefficient estimates in the probit model and the low baseline probability of being diagnosed with PTSD in the sample, a logit model helps to illustrate the effect of the last deployment location on the probability of being diagnosed with PTSD.

The result of the logit model shows that if an Army officer was last deployed to Iraq, his odds of being diagnosed with PTSD increased by 4.2 times, compared to those not deployed overseas, *ceteris paribus*. Likewise, the odds of being diagnosed with PTSD increased by 2 times if an Army officer was last deployed to Afghanistan. Therefore we can conclude that despite the small magnitudes of the coefficient estimates in the probit models, they represented a significant increase in the probability of being diagnosed with PTSD for officers who were deployed overseas.

Besides the coefficient estimates for the last deployment location, several other coefficient estimates for the service and demographic characteristics in the probit model were also statistically significant. Table 6.3 shows that all the coefficient estimates for the military occupation codes were statistically significant and positive at the 0.05 level for the Navy. The effect of “Other MOS” was particularly striking. For an average Navy officer, his probability of being diagnosed increased by 0.98 if he belonged to the “Other MOS” category, compared to an average navy officer in the Combat Arms (reference group). The descriptive statistics in Table 6.1 show that 61% of the Navy PTSD sample belonged to the “Other MOS” category, while only 2.5% of the Navy non-PTSD sample belonged to the “Other MOS” category. The disproportionately higher percentage of officers categorized as “Other MOS” in the Navy PTSD sample, compared to its non-PTSD sample, could explain the large magnitude and high statistical significance of the “Other MOS” coefficient estimate for the Navy.

The descriptive statistics in Table 6.1 also showed that the “Other MOS” category constituted the largest percentage in the PTSD sample across the four services. This could explain why the coefficient estimates for the

“Other MOS” were statistically significant at the 0.01 level for all services (except for the Air Force). The military occupation codes were not included in the model for Air Force officers, because more than 98% of the observations were classified as “Other MOS” based on the information provided in the CTS data. Some of the categories for the military occupation codes were also merged for some services, e.g., “Medical,” were merged with “Other MOS” for the Air Force and Navy due to the small sample size in the individual categories. As the effect of MOS on the probability of being diagnosed with PTSD was not within the intended scope of this thesis, no further analysis was conducted to examine its effect. However, this is an area recommended for further research.

The coefficient estimates for the paygrades showed that the probability of being diagnosed with PTSD is 0.3 percentage point higher for Army officers with paygrade O1 to O3, compared to the warrant officers (reference group). The coefficient estimates for the Marine Corps also indicated that the probability of being diagnosed with PTSD was 0.002 lower for officers with paygrade O4 and above, compared to the warrant officers. These estimates were statistically significant at the 0.01 level, and suggested that junior officers were more likely to be diagnosed with PTSD compared to senior officers.

Most of the coefficient estimates for the various races were statistically insignificant. These indicated that no particular race was more vulnerable to PTSD risk among the officers in the four services.

The coefficient estimate for females was statistically significant at the 0.05 level across all four services. This indicated that female officers had a higher probability of being diagnosed with PTSD, compared to the male officers. The same observation was derived from the analysis of the descriptive statistics in Table 6.1. The coefficient estimate showed that the probability of a female officer being diagnosed with PTSD was 0.1 to 0.9 percentage points higher than for a male officer.

The coefficient estimate for marital status was not statistically significant at the 0.05 level across all four services. This indicated that there

was no significant difference in the probability of being diagnosed with PTSD between a married or a single officer.

The coefficient estimate for age was statistically significant at the 0.01 level across all four services, and indicated that the probability of being diagnosed with PTSD increased with age. The analysis from the descriptive statistics had also suggested that PTSD risk increased with age for the officers. However, the magnitudes of the coefficient estimates were very small at less than 0.03 percentage point.

Age is generally, but not necessarily, positively correlated with rank seniority and paygrades, i.e., an older service member is usually more senior in rank and paygrade, compared to a younger service member. The coefficient estimates for the paygrade and age had shown two contradicting effects on the probability of being diagnosed with PTSD. The estimates indicated that PTSD risk increased with age, but decreased with paygrade seniority. Based on the magnitudes of the estimates, we had expected the effect of the paygrade to be more significant than that of age.

2. Enlisted Personnel

Table 6.4 shows the result of the first probit model for the enlisted personnel across the services. Similar to the officers, most of the coefficient estimates for the last deployment location were statistically significant at the 0.01 level. In addition, the magnitudes of the coefficient estimates were larger than those of the officers. These indicated that the last deployment location had a larger effect on the enlisted personnel than on the officers. The effect of the last deployment location for the enlisted in each service is described below.

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Last Deployment Location and Location Type				
Afghanistan	0.016*** (0.001)	0.000 (0.001)	0.013*** (0.002)	-
Iraq	0.039*** (0.001)	0.006*** (0.001)	0.027*** (0.001)	-
Other Middle East	0.032***	-0.001***	0.020***	-

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Countries	(0.001)	(0.000)	(0.001)	
Other Countries	0.015*** (0.001)	-0.001*** (0.000)	0.013*** (0.001)	-
Shore Deployment in Afghanistan	-	-	-	0.003 (0.002)
Shore Deployment in Iraq	-	-	-	0.044*** (0.005)
Shipboard Deployment in Afghanistan or Iraq	-	-	-	0.029*** (0.003)
Shore Deployment in Other Middle East Countries	-	-	-	-0.001*** (0.000)
Shipboard Deployment in Other Middle East Countries	-	-	-	0.023*** (0.002)
Shore Deployment in Other Countries	-	-	-	-0.006*** (0.000)
Shipboard Deployment in Other Countries	-	-	-	0.001*** (0.000)
Military Occupation Codes				
Combat Support	-0.004*** (0.000)	-	-0.001*** (0.000)	-0.001 (0.000)
Combat Service Support	-0.003*** (0.000)	0.001*** (0.000)	-0.001*** (0.000)	0.001 (0.001)
Aviation	-	-	-0.003*** (0.000)	-0.000 (0.001)
Medical	-0.003*** (0.000)	-	-	-
Other MOS	0.008*** (0.000)	0.029*** (0.002)	0.179*** (0.009)	0.003*** (0.000)
Paygrade				
E4	0.001*** (0.000)	-0.000 (0.000)	-0.001*** (0.000)	0.001*** (0.000)
E5	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	0.000 (0.000)
E6	-0.003*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.001*** (0.000)
E7 to E9	-0.004*** (0.000)	-0.002*** (0.000)	-0.004*** (0.000)	-0.001*** (0.000)
Demographics				
Black	-0.002*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Hispanic	-0.002*** (0.000)	0.000 (0.000)	-0.001*** (0.000)	-0.000*** (0.000)

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Asian	-0.004*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
Other Races	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Female	0.011*** (0.000)	0.007*** (0.000)	0.010*** (0.001)	0.012*** (0.001)
Single	-0.004*** (0.000)	-0.001*** (0.000)	-0.003*** (0.000)	-0.001*** (0.000)
Age	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Fiscal Year of Observation				
FY2002	-0.001*** (0.000)	0.000 (0.000)	0.001* (0.001)	-0.000 (0.000)
FY2003	-0.001*** (0.000)	0.001*** (0.000)	0.001* (0.001)	0.001*** (0.000)
FY2004	0.001** (0.000)	0.001*** (0.000)	0.003*** (0.001)	0.002*** (0.000)
FY2005	0.005*** (0.001)	0.002*** (0.000)	0.009*** (0.001)	0.001*** (0.000)
FY2006	0.004*** (0.000)	0.001*** (0.000)	0.005*** (0.001)	-0.001*** (0.000)
Observations	332970	112696	98695	134095
Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.4. Marginal Effect of Last Deployment Location and Type on Probability of Being Diagnosed with PTSD (Enlisted Personnel)

a. Army

All the coefficient estimates for the last deployment location were statistically significant and positive at the 0.01 level. The average Army enlisted personnel's probability of being diagnosed with PTSD increased by 0.016 or 0.039 if he was last deployed to Afghanistan or Iraq respectively, ceteris paribus. Similar to the officers, the enlisted personnel experienced the largest percentage point increase in their probability of being diagnosed with PTSD if they were last deployed to Iraq.

b. Air Force

The coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.01 level. The probability of being diagnosed with PTSD for an average Air Force enlisted personnel increased by 0.006 if he was last deployed to Iraq, compared to those who were not deployed overseas. Similar to the officers, the magnitude of the coefficient estimate for enlisted personnel in the Air Force was much smaller than those for the Army or Marine Corps. These indicated that the increase in PTSD risk for both officers and enlisted personnel in the Air Force due to overseas deployment was smaller, compared to their peers in the Army or Marine Corps.

c. Marine Corps

Similar to the Army, all the coefficient estimates for the last deployment location were statistically significant and positive at the 0.01 level, and the probability of being diagnosed with PTSD for officers in the Marine Corps increased by the highest percentage point if they were last deployed to Iraq. However, the magnitudes of all the coefficient estimates for the Marine Corps were smaller than the corresponding estimates for the Army.

d. Navy

Unlike the coefficient estimates for the officers, most of the coefficients estimates for the Navy enlisted personnel were statistically significant at the 0.01 level. The coefficient estimates for the enlisted personnel had different signs, but the magnitudes of the positive coefficient estimates had much larger magnitudes than those of the negative coefficient estimates. The probability of being diagnosed with PTSD for an average enlisted sailor increased the greatest (by 0.044) if he was last deployed ashore in Iraq, while the probability increased only by 0.029 if he was last deployed afloat in Iraq or Afghanistan. These estimates supported our hypothesis that the probability of being diagnosed with PTSD was higher for sailors who were last deployed ashore, compared to sailors who were last

deployed onboard ship. As a matter of fact, the magnitude of the Navy coefficient estimate for shore deployment in Iraq was larger than the magnitude of the Army coefficient estimate for Iraq.

Most of the coefficient estimates for the military occupation codes were statistically significant at the 0.01 level. The coefficient estimates indicated that for the Army and Marine Corps, enlisted personnel in the Combat Support and Combat Service Support Arms had a lower probability of being diagnosed with PTSD, compared to those in the Combat Arms (reference group). This was also observed from the analysis of the descriptive statistics in Table 6.2. Similar to the “Other MOS” category for the officers, the coefficient estimate for the “Other MOS” category was statistically significant and positive at the 0.01 level for all four services

Almost all the coefficient estimates for the paygrades were statistically significant and negative at the 0.01 level. These indicated that the reference group, i.e., the most junior enlisted personnel (E1 to E3) had higher probability of being diagnosed with PTSD, compared to the more senior enlisted personnel.

The race coefficient estimates for the “Black,” “Hispanic” (except for the Air Force) and “Asian” were statistically significant and negative at the 0.01 level for all services. These indicated that black, Hispanic and Asian enlisted personnel had a lower probability of being diagnosed with PTSD compared to whites (reference group).

Similar to the officers, the coefficient estimate for females was statistically significant at the 0.01 level for all services, and indicated that females were more likely to be diagnosed with PTSD compared to the male enlisted personnel. The probability of female enlisted personnel in the Army, Marine Corps and Navy being diagnosed with PTSD was more than 1 percentage point higher than the male enlisted personnel.

Table 6.4 also shows that single enlisted personnel across all services were less likely to be diagnosed with PTSD, compared to married enlisted personnel. These estimates were statistically significant at the 0.01 level. The

probability of single enlisted personnel in the Army and Marine Corps being diagnosed with PTSD was 0.4 and 0.3 percentage points lower than the married personnel.

Similar to the officers, the coefficient estimate for age was statistically significant at the 0.01 level across all four services, and indicated that the probability of being diagnosed with PTSD increased with age. The magnitudes of the age coefficient estimates were again very small at less than 0.03 percentage points. Therefore similar to the officers, the coefficient estimates for paygrade and age showed opposite effects on the probability of being diagnosed with PTSD, even though paygrade and age were usually positively correlated. We had expected the paygrade effect to dominate the age effect, as the magnitudes of the paygrade estimates were greater than the magnitudes of the age estimates.

Finally, it was observed that all of the coefficient estimates for FY2004 to FY2006 were positive and statistically significant at the 0.05 level for all services (except FY2006 for Navy). These estimates indicated that the probability of being diagnosed with PTSD increased in these years, compared to the base year FY2001. The trend analysis in Chapter V also identified a surge in the number of PTSD cases during the period FY2004 to FY2006. These clearly showed the effects of OIF and OEF on the enlisted personnel.

D. RESULTS OF MULTIVARIATE ANALYSIS MODEL 2 – INTERACTIVE EFFECT OF LAST DEPLOYMENT LOCATION AND DURATION

The second multivariate probit model was an expansion of the first model. The second model estimated the effect of the last deployment location and duration on the probability of being diagnosed with PTSD. All deployments were categorized as short, medium and long deployments based on their duration. As the deployment duration differed between the services, the interval definition for short, medium and long deployments was determined by the distribution of the deployment duration for each service in the empirical data. The cutoffs for the intervals for each service were chosen so that each interval contained approximately the same percentage of

observations across the four services.⁴⁵ In addition, the model also employed interaction terms between the last deployment location and duration to examine whether the effect of deployment duration on being diagnosed with PTSD was exacerbated or migrated by the deployment location.

Similar to the first model, the last deployment refers to the most recently completed deployment prior to the PTSD diagnosis date or date of observation. The key variables of interest for the second models were the last deployment location, its duration and the interaction terms between the last deployment location and duration.

The second model also included a set of control variables for the service and demographic characteristics of the sample. The result of the second model shows that the effects of these control variables on the probability of being diagnosed with PTSD were similar to those in the first model. Hence the effects of these control variables were not reported in the second and subsequent models, unless their effects varied significantly.

1. Officers and Warrant Officers

Table 6.5 shows the result of the second probit model for the officers and warrant officers across the services. Due to small sample size for some of the interaction terms, only two interaction terms, namely “medium deployment duration in Afghanistan or Iraq” and “long deployment duration in Afghanistan or Iraq”, were included in the model.

Reference group: Married white male, in the most junior rank category and in combat arms, with a short last deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Last Deployment Duration				
Medium	0.002* (0.001)	0.001 (0.001)	-0.001 (0.001)	0.000 (0.000)
Long	0.003*** (0.001)	0.004** (0.002)	-0.001 (0.001)	-0.000 (0.000)
Last Deployment Location				
Afghanistan	0.003**	-0.001*	0.007	-0.000***

⁴⁵ Based on the deployment duration, approximately 80% of the observations in each service were categorized as a short deployment, while the next 10% of the observations were categorized as a medium deployment. The remaining 10% of the observations was categorized as a long deployment.

Reference group: Married white male, in the most junior rank category and in combat arms, with a short last deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Iraq	(0.001) 0.009*** (0.002)	(0.000) 0.002 (0.000)	(0.006) 0.009** (0.004)	(0.000) 0.000 (0.001)
Other Middle East Countries	0.007***	-0.002***	0.005***	-0.000
Other Countries	(0.001) 0.001 (0.001)	(0.002) -0.002*** (0.000)	(0.002) 0.004** (0.002)	(0.000) -0.001*** (0.000)
Interaction Terms				
Medium Deployment * (Afghanistan or Iraq)	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.001)	0.000 (0.002)
Long Deployment * (Afghanistan or Iraq)	-0.001 (0.001)	-0.001** (0.000)	-0.000 (0.002)	0.004 (0.005)
Observations	48952	22593	8927	15518
Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.5. Marginal Effect of Last Deployment Location and Duration on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers)

In general, Table 6.5 shows that the effect of the last deployment location was more statistically and numerically significant than the effect of the last deployment duration, i.e., the last deployment location had a larger effect on the officers' probability of being diagnosed with PTSD than their last deployment duration, except for the Air Force. The effect of the last deployment duration also appeared to be independent of the last deployment location for the officers. The result of the model for each service is described below.

a. Army

The coefficient estimate for the long deployment was statistically significant at the 0.01 level. For an average Army officer, his probability of

being diagnosed with PTSD increased by 0.003 if the duration of his last deployment was long, as compared to an officer who had had a short last deployment. Similar to model 1, the coefficient estimates for Afghanistan, Iraq and other Middle East countries were statistically significant and positive. However, the magnitudes of these estimates were smaller than those in model 1. For instance, the coefficient estimate for Iraq was 1.3 and 0.9 percentage point in model 1 and 2 respectively. The coefficient estimate for the last deployment location in model 1 had included the effect of the deployment duration, while the effect of the last deployment location and duration was analyzed separately in model 2.

b. *Air Force*

Similar to the Army, the magnitudes of the coefficient estimates for the last deployment location in model 2 were smaller than those in model 1, when the effect of the last deployment duration was analyzed separately from the effect of the deployment location in model 2. The result also showed that for an average Air Force officer, the probability of being diagnosed with PTSD increased by 0.004 if the last deployment was long compared to an officer who had a short last deployment. These indicated that Air Force officers were more affected by the duration of their last deployment than its location. Interestingly, the increase in the probability of being diagnosed with PTSD due to a long last deployment (0.4 percentage point) was mitigated or decreased by 0.1 percentage point if the last deployment was in Afghanistan or Iraq.

c. *Marine Corps*

The coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.05 level. Contrary to the Army and Air Force, the magnitudes of the coefficient estimates for the last deployment location increased slightly when the effect of the last deployment duration was analyzed separately from the last deployment location, and the coefficient estimates for the deployment duration (medium and long deployments) were not statistically significant.

d. Navy

Model 1 has shown that there is little differential effect on the probability of being diagnosed with PTSD for officers who are deployed ashore or afloat. Hence the deployment location type was omitted in model 2 for the Navy. The coefficient estimates for Afghanistan and other countries were statistically significant and negative at the 0.01 level. However the magnitude of these estimates was small at 0.1 percentage point and less.

2. Enlisted Personnel

Table 6.6 shows the result of the second probit model for the enlisted personnel across the four services. The coefficient estimates show that the enlisted personnel were more affected by the last deployment location and duration than the officers. Enlisted personnel from all services experienced the largest percentage point increase in their probability of being diagnosed with PTSD if they were last deployed to Iraq. Similar to the effects on the officers, the effect of the last deployment location was more numerically significant than the effect of the last deployment duration for all services, except the Air Force. The duration effect also generally appeared to be independent of the last deployment location. The result for each service is described below.

Reference group: Married white male, in the most junior rank category and in combat arms, with a short last deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Last Deployment Duration				
Medium	0.000 (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.001)
Long	0.005*** (0.000)	0.003*** (0.001)	-0.001 (0.001)	0.000 (0.000)
Last Deployment Location				
Afghanistan	0.012*** (0.001)	-0.001*** (0.000)	0.015*** (0.003)	0.004 (0.002)
Iraq	0.028*** (0.001)	0.002** (0.001)	0.031*** (0.002)	0.017*** (0.005)
Other Middle East Countries	0.028*** (0.001)	-0.001*** (0.000)	0.018*** (0.001)	0.002*** (0.000)
Other Countries	0.014*** (0.001)	-0.001*** (0.000)	0.012*** (0.001)	-0.005*** (0.000)
Interaction Terms				
Medium Deployment * (Afghanistan or Iraq)	0.001* (0.001)	0.001 (0.001)	-0.002*** (0.000)	0.006* (0.003)
Long Deployment * (Afghanistan or Iraq)	0.000 (0.000)	0.001 (0.001)	0.000 (0.001)	0.008** (0.003)
Observations	332970	112696	98695	134095
Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.6. Marginal Effect of Last Deployment Location and Duration on Probability of Being Diagnosed with PTSD (Enlisted Personnel)

a. Army

The coefficient estimate for the long deployment was statistically significant at the 0.01 level. For average Army enlisted personnel, the probability of being diagnosed with PTSD increased by 0.005 if the duration of the last deployment was long, compared to enlisted personnel who had short

last deployments. Similar to model 1, the coefficient estimates for all locations were statistically significant and positive. However, as for the officers, the magnitudes of these estimates were smaller than those in model 1.

b. Air Force

All the coefficient estimates for the deployment locations and duration were statistically significant at the 0.05 level. Similar to the results for the officers, the magnitudes of the coefficient estimates for the last deployment location in model 2 were smaller than those in model 1. The sign and relative magnitude of the coefficient estimates indicated that enlisted personnel in the Air Force are more affected by the duration of their last deployment than its location. In addition, the coefficient estimate for the deployment duration showed that a long deployment increased the probability of being diagnosed with PTSD more than a medium deployment, as we expected.

c. Marine Corps

As in model 1, the coefficient estimates for all locations were statistically significant and positive at the 0.01 level. In addition, the coefficient estimate for the medium deployment was also statistically significant at the 0.01 level. For average enlisted personnel in the Marine Corps, the probability of being diagnosed with PTSD increased by 0.001 if the last deployment was of medium duration, compared to other enlisted personnel with short last deployments. Interestingly, the increase in the probability of being diagnosed with PTSD due to a medium deployment was negated if the last deployment was in Iraq or Afghanistan.

d. Navy

Similar to model 1, the coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.01 level. In addition, the coefficient estimate for the medium deployment was statistically significant at the 0.01 level. Although the coefficient estimate for the long deployment was statistically insignificant, the coefficient estimate

for the interaction term “long deployment in Afghanistan or Iraq” was statistically significant at the 0.05 level. This indicated that the effect of the deployment duration on the probability of being diagnosed with PTSD was exacerbated if the last deployment was Afghanistan or Iraq.

E. RESULTS OF MULTIVARIATE ANALYSIS MODEL 3 – EFFECT OF DEPLOYMENT LOCATION HISTORY

The first two probit models focused on the effect of the last deployment on the probability of being diagnosed with PTSD. The third model extended the analysis to include all past deployments in the person’s deployment history that occurred before his PTSD diagnosis date or date of observation. The model considered if a person had ever been deployed to the various locations between FY2001 and FY2006, and prior to his PTSD diagnosis date or date of observation, and estimated the effect of ever being deployed to these locations on the probability of being diagnosed with PTSD. The key variables of interest for the third model were the locations of the past deployments.

1. Officers and Warrant Officers

Table 6.7 shows the result of the third probit model for the officers and warrant officers across the services. The result shows that, except for the Navy, the probability of an officer being diagnosed with PTSD increased if he was ever deployed to Iraq. The result for the services is described below.

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Has ever being deployed to				
Afghanistan	0.002** (0.001)	-0.001 (0.001)	0.002 (0.003)	-
Iraq	0.006*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	-
Other Middle East Countries	0.007*** (0.001)	-0.001*** (0.000)	0.003*** (0.001)	-
Other Countries	0.000 (0.001)	-0.001*** (0.000)	0.002* (0.001)	-
Shore Deployment in Afghanistan	-	-	-	-0.000* (0.000)

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Shore Deployment in Iraq	-	-	-	0.003* (0.002)
Shipboard Deployment in Afghanistan or Iraq	-	-	-	0.000 (0.001)
Shore Deployment in Other Middle East Countries	-	-	-	-0.000*** (0.000)
Shipboard Deployment in Other Middle East Countries	-	-	-	0.002 (0.001)
Shore Deployment in Other Countries	-	-	-	-0.001*** (0.000)
Shipboard Deployment in Other Countries	-	-	-	0.000* (0.000)
Observations	48952	22593	8927	15518
Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.7. Marginal Effect of Deployment Location History on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers)

a. Army

The coefficient estimate for Afghanistan, Iraq and other Middle East countries were statistically significant and positive at the 0.05 level. For an average Army officer, his probability of being diagnosed with PTSD increased by 0.002 and 0.006 respectively if he was ever deployed to Afghanistan or Iraq. Therefore if an officer was ever deployed to both Iraq and Afghanistan, his probability of being diagnosed with PTSD increased by 0.008, ceteris paribus.

b. Air Force

The coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.01 level. However, the coefficient estimate for Iraq was the only positive and numerically significant estimate. This reflected the adverse effect of deployments to Iraq, compared to the other deployment locations.

c. Marine Corps

The coefficient estimates for Iraq and other Middle East countries were statistically significant at the 0.01 level. The coefficient estimate for Afghanistan was, however, not statistically significant at the 0.05 level.

d. Navy

All the coefficient estimates for the Navy incorporated the effect of deployment location type (ashore or afloat). Only the coefficient estimates for shore deployment in other Middle East countries and shore deployment in other countries were statistically significant at the 0.01 level. As a matter of fact, these two coefficient estimates were negative and suggested that the probability of being diagnosed with PTSD decreased if the officer was ever deployed ashore in other countries other than Afghanistan and Iraq. However, the magnitudes of these estimates were 0.1 percentage point and less.

2. Enlisted Personnel

Table 6.8 shows the result of the third probit model for the enlisted personnel across the services. The table indicates that, for all services, the probability of enlisted personnel being diagnosed with PTSD increased if they were ever deployed overseas. The result for each service is described below.

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Has ever being deployed to				
Afghanistan	0.006*** (0.001)	-0.000 (0.000)	0.005*** (0.001)	-
Iraq	0.016*** (0.000)	0.007*** (0.001)	0.014*** (0.001)	-
Other Middle East Countries	0.019*** (0.000)	-0.000*** (0.000)	0.012*** (0.001)	-
Other Countries	0.004*** (0.000)	-0.001*** (0.000)	0.006*** (0.001)	-
Shore Deployment in Afghanistan	-	-	-	0.003 (0.002)
Shore Deployment in Iraq	-	-	-	0.042*** (0.005)
Shipboard Deployment in Afghanistan or Iraq	-	-	-	0.024*** (0.003)
Shore Deployment in Other Middle East Countries	-	-	-	-0.001*** (0.000)
Shipboard Deployment in Other Middle East Countries	-	-	-	0.027*** (0.002)
Shore Deployment in Other Countries	-	-	-	-0.006*** (0.000)
Shipboard Deployment in Other Countries	-	-	-	0.002*** (0.000)
Observations	332970	112696	98695	134095
Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.8. Marginal Effect of Deployment Location History on Probability of Being Diagnosed with PTSD (Enlisted Personnel)

a. Army

All the coefficient estimates were statistically significant and positive at the 0.01 level. However the magnitudes of the estimates for Iraq and other Middle East countries were larger than those for Afghanistan and other countries. Similar to the results in models 1 and 2, the magnitudes of the estimates for the enlisted personnel were larger than those for the officers. These estimates indicated that the probability of an enlisted personnel being diagnosed with PTSD increased more substantially than for an officer, if he was ever deployed to both Afghanistan and Iraq.

b. Air Force

Similar to the officers, the coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.01 level for enlisted personnel. Again, only the coefficient estimate for Iraq was positive and numerically significant. This, again, reflected the adverse effect of deployments to Iraq on the probability of being diagnosed with PTSD, compared to the other deployment locations.

c. Marine Corps

Similar to the Army's results, all the coefficient estimates were statistically significant at the 0.01 level. Likewise, the magnitudes of these estimates were larger than the magnitudes of the corresponding estimates for the Marine Corps officers.

d. Navy

All coefficient estimates, except for the shore deployment in Afghanistan, were statistically significant at the 0.01 level. For average enlisted personnel in the Navy, the probability of being diagnosed with PTSD increased by 0.042 if they were ever deployed ashore in Iraq. The probability increased by 0.024 only they were ever deployed onboard ship in Iraq or Afghanistan. The relative magnitude of these estimates supported our hypothesis that the probability of being diagnosed with PTSD was higher for

sailors who ever deployed ashore, compared to sailors who were ever deployed onboard ship. Interestingly, the magnitude of the Navy coefficient estimate for shore deployment in Iraq was larger than the magnitude of the Army coefficient estimate for Iraq.

F. RESULTS OF MULTIVARIATE ANALYSIS MODEL 4 – EFFECT OF SINGLE AND MULTIPLE DEPLOYMENTS TO THE SAME LOCATION

The fourth model was an expansion of the third model. The fourth model considered all the past deployments in the person's deployment history between FY2001 to FY2006 that occurred prior to his PTSD diagnosis date or date of observation, and estimated the effect of a single deployment (i.e., only deployed once) and multiple deployments (i.e., deployed more than once) to the same location (as specified) on the probability of being diagnosed with PTSD. The key variables of interest were two sets of binary location variables for the single and multiple deployments to the various locations.

1. Officers and Warrant Officers

Table 6.9 shows the result of the fourth probit model for the officers and warrant officers across the four services. The coefficient estimates for some of the independent variables were not available due to limited data variation for these variables.

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Has been deployed only once to Afghanistan	0.002*** (0.001)	-0.000 (0.001)	0.003 (0.003)	0.001 (0.001)
Has been deployed more than once to Afghanistan	-0.001 (0.001)	-	-	-
Has been deployed only once to Iraq	0.006*** (0.001)	0.004*** (0.001)	0.004*** (0.002)	0.008** (0.004)
Has been deployed more than once to Iraq	0.009*** (0.003)	-	0.004 (0.004)	-
Has been deployed	0.006***	-0.001***	0.002***	0.002**

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
only once to other Middle East countries	(0.001)	(0.000)	(0.001)	(0.001)
Has been deployed more than once to other Middle East countries	0.012***	-0.001***	0.007*	0.003
	(0.002)	(0.000)	(0.004)	(0.003)
Has been deployed only once to other countries	0.001	-0.001***	0.002*	0.000
Has been deployed more than once to other countries	(0.001)	(0.000)	(0.001)	(0.000)
	-0.000	-0.001***	-0.000	0.000
	(0.001)	(0.000)	(0.002)	(0.001)
Has been shore-deployed only once	-	-	-	-0.001***
Has been shore-deployed more than once	-	-	-	(0.000)
				-0.000***
				(0.000)
Observations	48952	22513	8919	15510
Robust standard errors in parentheses				
* significant at 10%;				
** significant at 5%;				
*** significant at 1%				

Table 6.9. Marginal Effect of Single and Multiple Deployments to the Same Location on Probability of Being Diagnosed with PTSD (Officers and Warrant Officers)

a. Army

The coefficient estimates showed that repeated deployments to Iraq increased the probability of being diagnosed with PTSD. For an average Army officer, his probability of being diagnosed with PTSD increased by 0.006 if he was deployed only once to Iraq. The probability however increased by 0.009 if he was deployed more than once to Iraq. If the officer was only deployed once to Afghanistan, his probability of being diagnosed with PTSD

increased by 0.002. The coefficient estimate for multiple deployments to Afghanistan was however statistically insignificant at the 0.05 level.

b. Air Force

Similar to the previous model, the coefficient estimates for Iraq, other Middle East countries and other countries were statistically significant at the 0.01 level. However, only the coefficient estimate for single deployment to Iraq was positive and statistically significant. The coefficient estimate for multiple deployments to Iraq was not available due to limited data variation for multiple deployments to Iraq.

c. Marine Corps

For an average Marine Corps officer, his probability of being diagnosed with PTSD increased by 0.004 if he was deployed only once to Iraq. However, the coefficient estimate for multiple deployments to Iraq was statistically insignificant at the 0.05 level. This suggested that there was no significant difference in the probability of being diagnosed with PTSD between an officer who was deployed only once to Iraq, and an officer who had been deployed more than once to Iraq.

d. Navy

The probability of an average Navy officer being diagnosed with PTSD increased by 0.008 if he was deployed only once to Iraq. The magnitude of the increase in the probability of being diagnosed with PTSD for the Navy officer was in fact larger than the magnitude of the increase for an Army officer. Similar to the Air Force, the coefficient estimate for multiple deployments to Iraq was not available due to limited data variation for multiple deployments to Iraq.

2. Enlisted Personnel

Table 6.10 shows the result of the fourth probit model for the enlisted personnel across the four services. The coefficient estimates for the enlisted

personnel were more statistically and numerically significant, compared to those for the officers. The coefficient estimates showed that repeated deployments to Iraq increased the probability of being diagnosed with PTSD for enlisted personnel across all services. On the other hand, the probability of being diagnosed with PTSD did not increase significantly for enlisted personnel who were deployed multiple times to Afghanistan, compared to those who were only deployed once to Afghanistan.

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
Has been deployed only once to Afghanistan	0.007*** (0.001)	-0.000 (0.000)	0.005*** (0.001)	0.024*** (0.006)
Has been deployed more than once to Afghanistan	0.000 (0.001)	0.002 (0.003)	0.002 (0.004)	0.026 (0.036)
Has been deployed only once to Iraq	0.016*** (0.000)	0.007*** (0.001)	0.014*** (0.001)	0.073*** (0.006)
Has been deployed more than once to Iraq	0.027*** (0.002)	0.009*** (0.003)	0.028*** (0.005)	0.084*** (0.030)
Has been deployed only once to other Middle East countries	0.019*** (0.000)	-0.000*** (0.000)	0.010*** (0.001)	0.022*** (0.002)
Has been deployed more than once to other Middle East countries	0.030*** (0.002)	0.000 (0.000)	0.043*** (0.004)	0.059*** (0.009)
Has been deployed only once to other countries	0.005*** (0.001)	-0.001*** (0.000)	0.005*** (0.001)	0.001*** (0.000)
Has been deployed more than once to other countries	0.002* (0.001)	-0.001*** (0.000)	0.018*** (0.003)	0.006*** (0.001)
Has been shore-deployed only once	-	-	-	-0.006*** (0.000)
Has been shore-deployed more than once	-	-	-	-0.004*** (0.000)
Observations	332970	112696	98695	134095
Robust standard				

Reference group: Married white male, in the most junior rank category and in combat arms, with no overseas deployment. Base year FY2001				
Variable	Army	Air Force	Marines	Navy
errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%				

Table 6.10. Marginal Effect of Single and Multiple Deployments to the Same Location on Probability of Being Diagnosed with PTSD (Enlisted Personnel)

Although the coefficient estimates for single and multiple deployments to Iraq were statistically significant and positive at the 0.01 level across all services, the magnitudes of these coefficient estimates varied significantly among the services. The magnitudes of the coefficient estimates for the Army and Marine Corps were similar, while the magnitudes of the estimates for the Air Force were lower than those for the Army or Marine Corps, as expected. However, the magnitudes of the coefficient estimate for the Navy were significantly larger than those for the other three services. The probability of an enlisted personnel in the Navy being diagnosed with PTSD increased by 0.073 if he was deployed only once to Iraq. The probability increased by 0.084 if he was deployed more than once to Iraq. In fact, the magnitudes of several Navy coefficient estimates, e.g., single deployment to Afghanistan, single and multiple deployments to other Middle East countries were larger than the magnitudes of the corresponding estimates for the three other services. These indicated that Navy enlisted personnel may be more adversely affected by overseas deployments, particularly deployments to Iraq, compared to enlisted personnel in the three other services.

The Navy coefficient estimates for shore deployments indicated that the probability of a Navy enlisted personnel being diagnosed with PTSD decreased by 0.006 or 0.004 if he was deployed ashore once only or more than once respectively. By comparing the magnitudes of the coefficient estimates for deployment locations and shore deployments, we observed that

the effect of the deployment location was more significant than the effect of the deployment location type (ashore or afloat).

G. SUMMARY

This chapter employed four multivariate analysis models to estimate the effect of the various aspects of deployment intensity, including deployment location, duration and frequency on the probability of being diagnosed with PTSD across the four services. Separate analyses were conducted for officers and enlisted personnel.

The multivariate analyses showed that overseas deployments, particularly deployments to Iraq, increased the probability of being diagnosed with PTSD. The effect of deployments to Afghanistan was less significant compared to the effect of deployments to Iraq. As the duration and frequency of deployments increased, the probability of being diagnosed with PTSD also increased, particularly for the enlisted personnel. However, the effect of the deployment duration was independent of the deployment location for most deployment locations across the services.

The multivariate analyses also showed that the magnitudes of the coefficient estimates for the enlisted personnel were consistently larger than those for the officers. The increase in the probability of being diagnosed with PTSD due to overseas deployments was more significant for the enlisted personnel, compared to the officers.

For officers, the effects of overseas deployment were more pronounced in the Army and the Marine Corps, compared to the Air Force and Navy, as we had hypothesized. However for enlisted personnel, we observed in several of our analyses that overseas deployments had a greater effect on the probability of being diagnosed with PTSD for the Navy sailors than for the soldiers in the Army and Marine Corps.

We had hypothesized that the probability of being diagnosed with PTSD was higher for sailors who were deployed ashore, compared to the sailors who were deployed on ships, as the former were expected to face higher threats. The results from the analyses for the Navy enlisted personnel

supported this hypothesis. However, we did not observe any statistically significant difference in the probability of being diagnosed with PTSD between Navy officers who were deployed on ships and those who were deployed ashore.

In summary, the multivariate analyses allowed us to compare the effect of the various aspects of deployment intensity across the services, as well as between the officers and the enlisted personnel, while holding other factors constant. While most results from the multivariate analyses supported our hypothesis, we had also gained some new insights.

The next chapter will analyze the pattern of comorbidity risks and treatment costs for PTSD across the four service branches at two different levels of resolution, namely at the claim and person level. Chapter VII will establish whether there is a differential comorbidity distribution or treatment cost between officers and enlisted personnel, males and females, and between white and non-white populations in the four services.

THIS PAGE INTENTIONALLY LEFT BLANK

VII. IN-DEPTH ANALYSIS OF THE PTSD POPULATION OF THEIR TREATMENT COST, COMORBIDITY AND OTHER USEFUL CLINICAL INFORMATION

A. OVERVIEW

The increasing trend of PTSD among active duty service personnel has created concerns over the rising trend in the medical costs of PTSD treatment across the services. Rising medical costs specific to PTSD treatment could divert funds away from other needs for the military. In addition to the treatment costs, it is important for the military planners to be conversant with the PTSD comorbidity distribution across the different services so as to take into consideration the appropriate assignment of the combat operational profiles of affected active duty service personnel.

This chapter of the study will be directed towards the assessment of comorbidity distribution and patterns of treatment costs for PTSD across the different branches of service among the active duty population who have been diagnosed with PTSD during the study period from FY2001 to FY2006. This portion of the study uses the clinical data in TRICARE inpatient and outpatient claim systems to derive the treatment cost patterns and clinical characteristics across the different branches.

B. ANALYTICAL APPROACH

For the purpose of analyzing the comorbidity and treatment cost patterns among the PTSD population across the services, the study uses the five data sets provided by TRICARE. They are the Defense Enrollment Eligibility Reporting System (DEERS) data on the PTSD population across the services, which provided the basic demographic information, as well as the identification of the PTSD diagnosis of the active duty service personnel; the data files of the Standard Inpatient Data Record (SIDR) and the TRICARE Encounter Data – Institutional (TEDI) that captured all treatment patterns among the PTSD population for those who were admitted under the inpatient setting; and the Standard Ambulatory Data Record (SADR) and TRICARE

Encounter Data – Non-Institutional (TEDN) data files which captured the treatment patterns among the PTSD population for those who were admitted to an outpatient setting.⁴⁶

The four clinical data files of SIDR, SADR, TEDI and TEDN would be used to assess the comorbidities associated with PTSD as well as deriving the average treatment costs both at the claims level, i.e. number of claims/visits made by all active duty service personnel to the respective MTFs and TRICARE providers (civilian medical services providers) and the individual encounters with the military and civilian treatment facilities. While the results from the overall claims level would present the overall trends of PTSD diagnosed personnel in terms of related comorbidity illnesses and treatment cost patterns, the analysis at the individual level would be further separated into the demographics component of gender and race to evaluate the possible differences in outcomes between the distinct groups of personnel. For the purpose of the study, only non-missing values would be evaluated for the comorbidity and treatment costs pattern.

1. DEFINITIONS OF MEDICAL CLASSIFICATIONS OF PTSD COMORBIDITY DISTRIBUTION AND OTHER NOMENCLATURES

There is substantial comorbidity between PTSD and disorders such as depression, which are responsive to pharmacotherapy. Up to 80% of patients with PTSD meet the criteria for at least one other psychiatric disorder. Other common comorbid disorders are many affective disorders, other anxiety disorders, somatisation and substance abuse.⁴⁷ Therefore, it is important to

⁴⁶ The SIDR data set contained 47,610 inpatient records/observations of active duty service personnel from the different branches who were diagnosed with PTSD and sought treatment or admitted to MTFs; the TEDI consisted of 43,339 records/observations of personnel who sought inpatient treatment at the civilian TRICARE medical services providers; the SADR included 2,699,758 records/observations of personnel who sought outpatient treatment at the MTFs, while the TEDN consisted of 1,130,799 observations of personnel who sought outpatient treatment at the TRICARE civilian providers during the entire study period.

⁴⁷KT, Brady (1997). *Posttraumatic stress disorder and comorbidity: recognizing the many faces of PTSD*. The Journal of Clinical Psychiatry 1997; 58 Suppl 9: 12-5.

identify the definitions of these comorbidities that are associated with PTSD.⁴⁸ Based on the *Diagnostic and Statistical Manual of Mental Disorders* (ICD-9 CM version) which is the standard classification of mental disorders used by mental health professionals in the United States,⁴⁹ the eight comorbidities associated with PTSD which are used in this study are summarized in the Table 7.1 below.

S/No.	Categories of Comorbidities	Diagnostic Codes (ICD 9 CM)
1.	Major Depression	296.2 and 296.3
2.	Substance Abuse	291 -292 and 303 -305
3.	Other psychoses	295-299, excluding 296.2 and 296.3
4.	Any other mental health problems	290-312 (excluding the above 3)
5.	External causes of injury	ICD-9 Codes starting with "E")
6.	Unspecified Mental and Behavioural problems	V40
7.	Other V-codes	Excludes V40 and V70 (general health examination)
8.	Acute Illnesses	Any ICD 9 code that is <290 and > 319, excluding E and V codes.

Table 7.1. Categories of Comorbidities Associated with PTSD

Given the clinical inpatient and outpatient data sets from TRICARE, the diagnostic codes (indicated as “dx” in the data sets) indicated above would be used for the in-depth analysis of the PTSD comorbidity distribution amongst the active duty service personnel across the different branches of services in the U.S military. For the purpose of the study, only the primary (dx1) and secondary (dx2) diagnostic codes for PTSD comorbidity illnesses were analyzed throughout the entire span of the study period.

In this study, all inpatient records/claims (visit) levels refer to all admissions to MTFs or TRICARE civilian hospitals as denoted by SIDR, and TEDI records and outpatient records/claims (visit) levels refer to all outpatient medical services rendered by MTFs or TRICARE civilian providers, as

⁴⁸ Robert Rosenheck & Alan Fontana (2003), Use of Mental Health Services by Veterans With PTSD After the Terrorist Attacks of September 11, *American Journal of Psychiatry* 2003; 160:1684–1690.

⁴⁹ Diagnostic and statistical manual of mental disorders: DSM-IV-TR. The American Psychiatric Association.

denoted by SADR and TEDN records respectively. In addition, the total number of claims mentioned in this study refers to the frequency of visits for treatment to either MTFs or TRICARE civilian medical providers made by the active duty service personnel who were diagnosed with PTSD between FY2001 and FY2006. On the other hand, the total number of individuals mentioned in this study would illustrate the number of personnel making the visits to MTFs or TRICARE civilian medical providers for their treatment regardless of the numbers of times of visits.

2. MERGING OF CLINICAL DATA SETS WITH DEERS DATA FILE ON PTSD POPULATION

The four clinical data sets of SIDR, TEDI, SADR and TEDN would be merged with the DEERS PTSD population data file⁵⁰ via the unique EDIPNs of the active duty service personnel. These merged data sets would then be further grouped according to the inpatient (SIDR and TEDI data sets) and outpatient (SADR and TEDN) level entities respectively, to capture the potentially different characteristics among different demographics (gender and race) seeking treatment at a MTF as compared to a civilian TRICARE provider.

The two merged inpatient (SIDR and TEDI) and outpatient (SADR and TEDN) data sets would be differentiated via the claims (visits) levels and the individual level respectively. The merged data sets at claims levels (both inpatient and outpatient level) would encompass the numbers of times each PTSD diagnosed active service duty personnel received treatment at either MTF or civilian TRICARE medical providers or submitted medical claims during the entire span of the study period. At the individual level, the merged data sets would only be comprised of one unique EDIPN of each PTSD diagnosed personnel regardless of the number of visits or claims he made while receiving treatment at MTF or civilian medical providers. The potential

⁵⁰ The data captured all the demographics information (age, gender, race, military pay grade, years of service etc) of the active duty service personnel who were diagnosed with PTSD between FY2001 and FY2006.

variability between the different gender and race would be evaluated at the individual level in the subsequent sections, holding all other factors constant.

C. ANALYSIS OF PTSD COMORBIDITY DISTRIBUTION AND TREATMENT COSTS ACROSS SERVICES AT CLAIMS LEVEL

This section concentrates on both the analysis of the PTSD comorbidity distribution and average treatment costs for inpatient and outpatient visits at claims levels for both the officers and enlisted population across the four branches of services between FY2001 and FY2006. The analysis includes mental health illness indicators for comorbidity distribution associated with PTSD, frequency of visits to MTFs and TRICARE civilian medical providers, average treatment costs and average length of stay at hospitals or treatment facilities for the officers and enlisted population across the services. The analysis is divided into the officer population and the enlisted population based on both inpatient and outpatient level records from the military as well as the civilian treatment facilities. Inpatient settings referred to admissions to treatment facilities or civilian hospitals for comprehensive treatment for severe PTSD related cases, while outpatient visits refers to visits for medication, rehabilitation and behavioral therapy and counseling for the affected active duty service personnel across the services.

1.1 Officers and Warrant Officers PTSD Population – Inpatient Visits (Refer to Table 7.2)

As gathered from the merged inpatient data file, there were only a total of 150 claims (visits) among the officers population across the different branches of services, with the Army having the most number of officers' claims (90) who sought treatment under all inpatient setting, i.e. had incidences of admissions to either MTFs or TRICARE civilian medical providers.

a. Mental Health Illness Indicators

As derived from the existing data information and shown in Table 7.2, it was found that depression remained the dominant comorbidity

associated with PTSD across the services and had the highest incidences of inpatient treatment/admissions besides PTSD. Amongst the officer population that was diagnosed with PTSD between FY2001 and FY2006, there was a significantly higher percentage of the PTSD population being diagnosed with depression and seeking treatment across the different branches of services. For instance, 63.6% of the officers from the Marine Corps' PTSD population were also diagnosed with depression and were given inpatient treatment; while 60% of the Army officers also suffered from depression besides being diagnosed with PTSD. These results were in line with the findings from existing literature on PTSD occurrences among active duty service personnel who were deployed in combat zones. It is also meaningful to also note that more than 30% of the officers from the Air Force and the Navy were also diagnosed with depression besides PTSD among the inpatient records. This could imply that personnel from these two services could suffer from the same comorbidity associated with PTSD (depression) even though they could have distinctly different operational profiles as compared with the Army or the Marine Corps.

Besides depression being the predominant comorbidity associated with PTSD, substance abuse (includes alcohol and drugs) and other mental illnesses were also comorbidities that had a certain extent of impact on the officers' PTSD population (as depicted in Table 7.2). For instance, while the officers from Army and Marine Corps had high percentages of being diagnosed with substance abuse in conjunction with PTSD, it is interesting to note that 18% of the Air Force officers (approximately 4% more than the Army officers) suffered from substance abuse. In addition, Air Force officers registered the highest percentage (27.3%) among the PTSD officer population of being concurrently diagnosed with other mental health related illnesses as compared to either Army or Marine Corps. This finding is especially important when there are no other substantial informational statistics on the PTSD incidences from the Air Force or the Navy in the current literature.

Officers (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Depression	6.0	17.2	36.4	21.2	63.6	23.8	31.3	16.6
Substance Abuse	14.4	1.8	18.2	1.4	27.3	2.9	12.5	5.4
Other Psychosis	8.9	1.3	9.1	7.6	27.3	4.0	6.3	2.8
Other Mental Health Illness	14.4	16.7	27.3	16.8	18.2	12.5	25.0	19.1
Unspecified mental and behavioral problems (V40)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External causes of Injury	1.1	0.0	3.0	0.1	0.0	1.1	0.0	0.2
Other V-code diagnoses (excluding V40)	25.6	8.1	30.3	14.0	18.2	12.5	37.5	10.3
Acute illness (any numerical ICD 9 that is <290 and >319, exclude E and V codes)	41.1	8.7	48.5	12.5	9.1	4.3	68.8	6.5
Count of Mental Illness Comorbidity								
0	14.4	65.2	12.1	58.2	0.0	59.3	31.3	59.1
1	73.3	32.6	84.9	36.5	63.6	38.2	62.5	38.2
2	12.2	2.2	3.0	5.3	36.4	2.5	6.3	2.5
>2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Count of Acute Illness Comorbidity								
0	45.6	84.6	30.3	76.7	72.7	83.0	12.5	84.0
1	41.1	14.0	57.6	19.9	27.3	16.1	68.8	15.0
2	13.3	1.4	12.1	3.4	0.0	0.9	18.8	1.0
>2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Visit Sites								
MTF	50.0	64.6	39.4	60.1	45.5	48.4	56.3	74.0
TRICARE Civilian Providers	45.6	12.3	54.6	18.7	27.3	13.1	31.3	14.4
Both MTF and TRICARE Civilian Providers	4.4	23.1	6.1	21.2	27.3	38.5	12.5	17.8
Total number of Claims	90	9,727	33	3,500	11	1,230	16	2,978
Average Treatment Costs (\$)								
MTF								

Officers (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Total Cost	9,635	240	7,616	365	9,131	231	7,817	257
Total Pharmacy Cost		19		31		26		23
Total number of Claims	49	8,529	15	2,845	8	1,069	11	2,733
TRICARE Civilian Providers								
Bill Charged	10,494.6	198.0	16,560.3	175.0	17,309.9	163.5	4,995.6	143.5
Bill Allowed	4,205.5	131.7	9,725.8	126.9	9,662.1	95.9	2,499.9	95.7
Total number of Claims	45	3,448	20	1,398	6	635	7	774
Length of Stay(Average number of days)	10.7		12.4		10.5		6.8	
Number of Claims	90		33		11		16	

Table 7.2. PTSD Comorbidity Distribution for Officers and Warrant Officers PTSD Population across Services (Claims/Visits level)

While it was common for mental health related illness to dominate the PTSD comorbidity distribution pattern, acute illnesses (i.e. non mental health related illnesses) were also found to be one huge category of comorbidity that was associated with PTSD, with 68.8% of the Navy officers who sought inpatient treatment for acute illness as well; while more than 40% of the officers from the Army and Air Force were diagnosed with acute illnesses and admitted for treatment in addition to PTSD during the study period as shown in Table 7.2.

b. Frequency of Site Visits

Under the current Military Health System (MHS), the active duty service personnel could either visit MTFs or their TRICARE civilian medical providers for treatment of PTSD. Drawing reference to the visit sites under inpatient claims records, it was clear that the majority of the officer PTSD population (especially the Army and Navy) had visited MTFs for PTSD related treatment between FY2001 and FY2006, with the exception of 54.6% of the Air Force officers being admitted into civilian TRICARE facilities for PTSD related treatment. As found in the data, 27.3% of the officers from the Marine Corps (which was the highest percentage across the different services) had been admitted to both the MTFs and the civilian treatment facilities for PTSD related treatment during the study period.

c. Average Treatment Costs and Length of Stay

As found in the inpatient records, the average treatment costs for PTSD (and related illnesses) at the MTFs fell within the range of \$7,616 to \$9,635 per claim between FY2001 and FY2006, with the Army officers incurring the highest treatment costs of \$9,635 for being admitted and receiving treatment at MTFs. These costs were calculated based on the number of claims, i.e. 49 claims from the Army officers who were diagnosed with PTSD and received treatment at MTFs. Similarly for the average treatment costs at TRICARE civilian medical providers, the officers from the Marine Corps incurred the highest costs of \$17,309 for PTSD related

treatment. It is important to note that these high costs could be due to the small officers' sample size from the Marine Corps. Air Force officers incurred close to an average of \$17,000 of PTSD related treatment costs at the civilian medical providers. The amount of the average treatment costs could be further explained by the average length of stay at the treatment facilities (military and civilian) in view of the fact that a longer period of stay at the treatment facility, the higher the treatment costs. For instance, the average length of stay for Air Force Officers at treatment facilities was the longest among the services (12.4 days) while both the Army and Marine Corps officers reached an average of about 11 days for similar inpatient treatments.

1.2 Officers and Warrant Officers PTSD Population – Outpatient Visits (Refer to Table 7.2)

In contrast to the inpatient records for the officer population, there were many more claims from the officer population for outpatient treatment for a PTSD related diagnosis during the study period as shown in Table 7.2. There were a total of 17,435 counts of officers' claims or visits to the military and civilian treatment facilities for PTSD related treatment between FY2001 and FY2006, with the Army officers contributing the largest portion for outpatient PTSD treatment, i.e. a total of 9,727 claims made to outpatient services rendered at the MTFs or TRICARE civilian medical providers. The Air Force officers had 3,500 outpatient visits for PTSD related treatment during the span of the study period.

a. Mental Health Illness Indicators

Similar to the inpatient claims records, depression was also the dominant comorbidity associated with PTSD across the services and highest incidences of outpatient treatment amongst the officers PTSD population, with 23.8% of the Marine Corps officer population seeking treatment for depression as well. About 21% of the Air Force officers were also diagnosed with depression and were given outpatient treatment; while 17.2% of the Army officers sought treatment for depression and PTSD. These results were in

line with the findings from existing literature on PTSD occurrences among active duty service personnel who were deployed in combat zones.

Besides the fact that depression is the predominant comorbidity associated with PTSD, the percentage of the servicemen being diagnosed with other mental illnesses was also high for outpatient visits among the officer population. For instance, within the outpatient claims records as shown in Table 7.2, the officers from the Navy comprised the highest percentage, i.e. 19% of the officers also seeking treatment for other mental illness associated with PTSD. It is interesting to note that approximately 17% of the Air Force and Army officers too were treated for PTSD and other mental illnesses. This finding is especially enlightening as there are no other substantial informational statistics on the PTSD incidences from the Air Force or the Navy among current literature. In this case, both the Air Force and the Navy officers actually had higher incidences of outpatient visits for treatment of other mental illness associated with PTSD than the Army and Marine Corps officers.

b. Frequency of Site Visits

Drawing reference to the visit sites under outpatient claims records, it was clear that the majority of the officers' PTSD population (especially the Army and Navy) had visited MTFs for PTSD related outpatient treatment between FY2001 and FY2006, with the Navy officers constituting 74% of the population visiting only MTFs for outpatient PTSD treatment. As gathered from the data, the Marine Corps officers accounted for over 38% of its population which had gone to both the MTFs as well as the civilian treatment facilities for PTSD related outpatient treatment during the study period.

c. Average Treatment Costs

The average outpatient treatment costs for PTSD (and related illnesses) were relatively much lower than that of the inpatient admissions, with the cost at the MTFs between \$231 to \$365 per claim between FY2001

and FY2006. This could be due to the fact that there were many more outpatient services rendered to the affected service personnel and that their PTSD conditions were not severe enough to admit them for inpatient care.

The Air Force officers contributed to the highest average outpatient treatment costs of \$365 at MTFs at 2,845 claims, while 8,529 claims from the Army officers received treatment at MTFs at lower average treatment costs of \$240 per claim. Similarly, average treatment costs at the TRICARE civilian medical providers for the officers from the Army were the highest at \$198 for PTSD related treatment. Air Force officers incurred close to an average of \$175 of PTSD related treatment costs at civilian medical providers.

2.1 Enlisted PTSD Population – Inpatient Visits (Refer to Table 7.3)

Given the operational profiles and mission requirements of the different services, the enlisted population accounted for a much higher number of claims (visits) for PTSD related treatments at MTFs or the TRICARE civilian medical providers. There were a total of 3,702 inpatient claims (visits) among the enlisted population across the different branches of services, with the Army having the highest number of claims by enlisted personnel (2,256) under inpatient setting, i.e. had incidences of admissions to either MTFs or TRICARE civilian medical providers.

a. Mental Health Illness Indicators

As derived from the existing data, and shown in Table 7.3, it was found that depression remained the dominant comorbidity associated with PTSD among the enlisted personnel across the services and had the highest incidences of inpatient treatment/admissions. Amongst the enlisted population diagnosed with PTSD between FY2001 and FY2006, there was a significantly higher percentage of the PTSD population being diagnosed with depression and seeking treatment across the different branches of services. For instance, 42.8% of the Air Force enlisted PTSD population were treated for depression under an inpatient setting (admitted to hospitals); while nearly

35% of both the Army and Navy enlisted personnel were also treated for depression. It is also meaningful to note that a significantly large proportion of the enlisted personnel from the Air Force and the Navy suffered from similar PTSD comorbidity (depression) despite little evidence being found in the existing literature. This could imply that personnel from these two services might have suffered from the same comorbidity associated with PTSD (depression) even though they had distinctly different operational profiles as compared with the Army or the Marine Corps.

Substance abuse (alcohol and drugs) and other mental illnesses were also comorbidities that had a certain extent of impact on the enlisted PTSD population (as depicted in Table 7.3). For instance, as compared to the officer population, the enlisted personnel from the Army and the Marine Corps have higher percentages (28.6% and 38.3% respectively) of being admitted for substance abuse in conjunction with PTSD. This finding is in line with the “common belief” that the enlisted personnel were easily susceptible to substance abuse upon PTSD diagnosis. This could also be attributable to the fact that the enlisted personnel were much more likely to develop severe PTSD symptoms as compared to the officers, given that the enlisted personnel are responsible for the executional roles of the combat missions as compared to the officers who hold supervisory roles.

While it was common for mental health related illness to dominate the PTSD comorbidity distribution pattern, acute illnesses (i.e. non mental health related illnesses) were also found to be a large category of comorbidity that was associated with PTSD, with nearly 40% of the enlisted population across the board, being treated for acute illness under inpatient admissions during the study period.

b. Frequency of Site Visits

Similar to the findings for the officer population, it was clear that the majority of the enlisted PTSD population (especially the Army and Navy) had visited MTFs for PTSD related treatment between FY2001 and FY2006, with the Marine Corps enlisted personnel accounting for 77.9%, and 50% of

the Army enlisted personnel being admitted into MTFs only for PTSD related treatment. Overall, the Army enlisted personnel had the highest percentage of 8.6% of inpatient admissions at both the MTFs and civilian medical providers.

c. Average Treatment Costs and Length of Stay

As gathered from information in the inpatient records, the average treatment costs for PTSD (and related illnesses) at the MTFs among the enlisted population fell within the range of \$8,751 to \$10,164 per claim between FY2001 and FY2006; with the Air Force and Marine Corps enlisted personnel incurring the highest treatment costs of over \$10,000 per claim for being admitted and receiving treatment at MTFs. Similarly, for the average treatment costs at the TRICARE civilian medical providers, the enlisted personnel from the Marine Corps incurred the highest costs of \$9,894 for PTSD related admissions. The amount of the average treatment costs could be further explained by the average length of stay at the treatment facilities (military and civilian) in view of the fact that the longer a period of stay at the treatment facility, the higher the treatment costs. For instance, the average length of stay for the enlisted personnel at the treatment facilities across the Services was approximately 8-10 days, with the longest duration of stay for both the Army and Marine Corps enlisted personnel.

Enlisted Personnel (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Depression	34.4	9.1	42.3	19.0	28.6	13.3	33.9	15.7
Substance Abuse	28.6	6.7	22.2	6.0	38.3	13.3	25.2	8.6
Other Psychosis	10.2	2.0	11.0	2.2	7.2	1.7	6.5	2.9
Other Mental Health Illness	21.7	14.8	23.6	18.5	22.5	13.8	31.3	19.8
Unspecified mental and behavioral problems (V40)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External causes of Injury	3.2	0.2	0.7	0.0	4.4	3.5	3.5	0.8
Other V-code diagnoses (excluding V40)	26.8	9.9	18.7	11.9	47.0	15.9	46.0	9.6
Acute illness (any numerical ICD 9 that is <290 and >319, exclude E and V codes)	43.2	7.5	40.0	5.8	36.2	6.4	40.0	4.6
Count of Mental Health Illness Comorbidity								
0	18.0	69.3	11.0	58.3	15.2	60.8	13.8	56.5
1	70.0	28.9	78.5	37.8	73.1	36.4	75.5	40.2
2	12.6	1.8	10.5	3.8	11.8	2.8	10.7	3.2
>2	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1
Count of Acute Illness Comorbidity								
0	43.6	83.8	51.4	83.3	33.5	76.7	35.0	86.3
1	40.7	14.7	38.1	15.5	47.8	21.1	42.9	12.5
2	14.6	1.4	10.3	1.1	16.4	2.1	19.7	1.2
>2	1.2	0.0	0.2	0.0	2.3	0.2	2.4	0.0
Visit Site (%)								
MTF	50.0	78.6	30.0	67.5	77.9	84.9	64.6	86.9
TRICARE Providers	41.5	7.0	67.5	11.1	18.5	5.8	32.2	3.5
Both MTF and TRICARE Civilian Providers	8.6	14.4	2.6	21.4	3.6	9.3	3.1	9.6
Total Number of Claims	2,256	151,940	428	29,941	475	27,282	543	38,773
Average Treatment Costs (\$)								
MTF								

Enlisted Personnel (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Total Cost	9,910.86	235.20	10,164.29	370.89	10,127.63	257.91	8,751.18	266.08
Total Pharmacy Cost		17.47		29.84		24.14		24.17
Total Number of Claims	1,321	141,273	139	26,621	387	25,698	368	37,426
TRICARE Civilian Providers								
Bill Charged	9,764.05	249.88	9,654.25	329.87	9,893.54	272.34	8,483.73	223.43
Bill Allowed	5,123.97	174.69	4,217.74	171.89	5,198.67	136.37	3,961.47	149.12
Total Number of Claims	1,129	32,468	300	9,731	105	4,124	192	5,065
Length of Stay(Average number of days)	10.66		9.21		10.68		8.82	
Number of Claims	2,256		428		475		543	

Table 7.3. PTSD Comorbidity Distribution for Enlisted PTSD Population across Services (Claims/Visits level)

2.2 Enlisted PTSD Population – Outpatient Visits (Table 7.3)

In contrast to the inpatient records for the officer population, there were many more claims from the enlisted population for outpatient treatment for PTSD related diagnosis during the study period as shown in Table 7.3. There were a total of 247,936 enlisted personnel claims or visits to the military and civilian treatment facilities for PTSD related illness between FY2001 and FY2006, with the Army enlisted personnel contributing the largest portion for outpatient PTSD treatment, i.e. a total of 151,940 claims were made out to outpatient services rendered at the MTFs or TRICARE civilian medical providers, while the Navy enlisted personnel had 38,773 outpatient visits for PTSD related treatment during the span of the study period.

a. Mental Health Illness Indicators

On enlisted personnel inpatient claims records, other mental health illnesses accounted for more than 15% as the dominant comorbidity associated with PTSD outpatient treatment across the services. About 19.8% of the Navy enlisted personnel who sought outpatient treatment were also diagnosed with other mental health illness; while 18.5% of the Air Force enlisted personnel were also diagnosed with other mental health illness and were given outpatient treatment. In this case, both the Air Force and the Navy officers actually had higher incidences of outpatient visits for treatment of other mental health illness associated with PTSD than the Army and Marine Corps enlisted personnel.

b. Frequency to Visit Sites

Drawing reference to the visit sites in outpatient claims records, it was clear that majority of the enlisted PTSD population (especially the Marine Corps and the Navy with 84.9% and 86.9% respectively) had visited only MTFs for PTSD related outpatient treatment between FY2001 and FY2006, while only 78.6% of the Army enlisted personnel visited only MTFs for their treatment. The

Marine Corps enlisted personnel reported the highest percentage – 84.8% of outpatient treatment at the MTFs only. The Air Force enlisted personnel constituted the highest percentage of 67.5% of outpatient admissions at the TRICARE civilian medical providers during the same study period.

In contrast with the officer population, the enlisted population had a lesser tendency to visit TRICARE civilian providers for their PTSD related outpatient treatment. For example, the percentages for outpatient visits to these providers were generally below 10% across the Services, with the exception of 11.1% of the Air Force enlisted personnel given outpatient services at the civilian TRICARE facilities for PTSD related treatment. This difference in the visit sites between the enlisted personnel and the officers could be due to the fact that enlisted personnel were much more likely to go to the places (MTFs) they were familiar with and were relatively cheaper for treatment as compared to utilizing civilian healthcare services which could be more expensive to start with.

c. *Average Treatment Costs*

The average outpatient treatment costs for PTSD (and related mental health illnesses) at the MTFs were between \$235 to \$370 per claim between FY2001 and FY2006. This range of costs for enlisted personnel is slightly higher than for the officers and could be due to the fact that there were many more outpatient services rendered to affected enlisted personnel as compared to the officers.

The Air Force enlisted personnel contributed to the highest average outpatient treatment costs of \$370 at MTFs with 26,621 claims, while 141,273 claims from the Army enlisted personnel received treatment at MTFs at lower average treatment costs of \$235 per claim. Similarly, for the average treatment costs at TRICARE civilian medical providers, the enlisted personnel from the Air Force incurred the highest costs of \$330 for PTSD related treatment.

D. ANALYSIS OF PTSD COMORBIDITY DISTRIBUTION AND TREATMENT COSTS ACROSS SERVICES AT INDIVIDUAL LEVELS

This section will concentrate on the analysis of the PTSD comorbidity distribution and average treatment costs for inpatient and outpatient claims (visits) of both officers and enlisted populations based on individual levels across the four branches of service between FY2001 and FY2006. Analogous to the analysis at claims (visits) level, this analysis at the individual level is divided into the officer population and the enlisted population based on both inpatient and outpatient level records from the military as well as the civilian treatment facilities. The distinct difference between the analysis at the individual level (based on unique EDIPN) and at the claims level is that the latter focuses on each of the active duty service personnel whom has been treated at either MTFs of TRICARE civilian providers, i.e. regardless of how many times the individual submitted the claims (i.e. regardless on the numbers of times of visits to any treatment facilities) during the study period. To obtain the necessary results for analysis at the individual level across the services, the four clinical data sets (SIDR, SADR, TEDI and TEDN) are separately collapsed into streamlined files via unique EDIPNs.

1.1 Officers and Warrant Officers PTSD Population – Inpatient Visits (Refer to Table 7.4)

Based on Table 7.4, at an individual level, the Army had the most officers (total of 67) who had incidences of admissions to either MTFs or TRICARE civilian medical providers during the span of the study period, while the Air Force had 23 officers who had been admitted for PTSD related treatment.

a. Mental Health Illness Indicators

Similar to the analysis at the claims level, depression remained the dominant comorbidity associated with PTSD across the services and highest incidences of inpatient treatment/admissions besides PTSD. The results at the

individual level were generally at the same threshold as at the claims level; for instance, 71.4% of the officers from Marine Corps' PTSD population were also treated for depression and were admitted, while nearly 60% of the Army officers also suffered from depression besides being diagnosed with PTSD.

Besides depression being the predominant comorbidity associated with PTSD, substance abuse (alcohol and drugs) and other mental health illnesses were also comorbidities that had a certain extent of impact on the officers' PTSD population (as depicted in Table 7.4) just as in the outcomes for the claims level. In fact, at the individual level, the officers from Air Force and Marine Corps had higher percentages (21% and 43% respectively) of being admitted into treatment facilities/hospitals for substance abuse in conjunction with PTSD treatment than at the claims level. At the individual level, the proportion of active duty service personnel who were admitted for acute illness was generally high (i.e. more than 45%) across the services with the exception of the Marine Corps (only 14.3%). For instance, the Navy officers showed 66.7% of the population being admitted for acute illness while 47.8% of the Air Force officers and 46.3% of the Army officers were admitted for acute illness.

b. Frequency of Site Visits

At the individual level, the Marine Corps officers had the highest percentage (71.4%) of the population being admitted only at the MTFs, while both the officers from the Army and Air Force constituted 52% of the admissions for PTSD related illnesses at the MTFs. For the inpatient admission at the civilian providers from TRICARE, the Air Force officers had the highest percentage of 43.5% admissions at individual level as compared to the rest of the services.

c. Average Treatment Costs and Length of Stay

From the individual perspective, the average treatment costs for PTSD (and related illnesses) for both the MTFs and the civilian providers were

relatively higher than that of the claims level since the individual data files would have a much smaller base to spread the total costs for treatment during all visits to the facilities. For instance, the average treatment costs for an Army officer between FY2001 and FY2006 was at \$12,954 for being admitted and receiving treatment at MTFs. This cost is calculated based on the number of Army officers, i.e. 67 personnel were diagnosed with PTSD and received treatment at MTFs. Similarly for the average treatment costs at the TRICARE civilian medical providers, the officers from the Marine Corps incurred the highest costs of \$51,929 per person for PTSD related treatment during hospital admissions. This inflated amount could be attributed to the small officer sample size from the Marine Corps (i.e. there were only 6 officers in the data). The amount of the average treatment costs could be further explained by the average length of stay at the treatment facilities (military and civilian) in view of the fact that the longer a period of stay at the treatment facility, the higher the treatment costs. For instance, the average length of stay for Air Force Officers at the treatment facilities was the longest among the services (17.3 days) while both the Army and Marine Corps officers reached an average of nearly 15 days for hospital admissions for PTSD treatment.

1.2 Officers and Warrant Officers PTSD Population – Outpatient Visits (Refer to Table 7.4)

On the whole, the trends for the outpatient visits at the individual level analysis were very much like the claims level, with the only difference being the magnitude of the various categories of comparison. The number of officers who received outpatient treatment for PTSD related illnesses was highest for the Army, i.e. 1,202 among the four services between FY2001 and FY2006. The Marine Corps officers appeared to have the lowest number of individuals – 126, seeking outpatient treatment at both the military and civilian treatment facilities.

a. *Mental Health Illness Indicators*

Similar to the analysis at the claims level, depression remained the dominant comorbidity associated with PTSD across the services and had the highest incidence of inpatient treatment/admissions besides PTSD. The results at the individual level were generally at the same threshold as at the claims level; for instance, the Marine Corps officers had the highest percentage of 23% seeking outpatient treatment for depression.

Besides depression being the predominant comorbidity associated with PTSD, at the individual level, there were more officers being treated under the outpatient setting for other PTSD related mental health illnesses than for substance abuse. In fact, the officers from Air Force and Navy had significantly higher percentages (30% and 28% respectively) of receiving outpatient treatment from military and civilian treatment facilities for other mental health illnesses than the Army or Marine Corp officers.

b. *Frequency of Site Visits*

At the individual level, as high as 83.4% of the Navy officers sought outpatient treatment at the MTFs only; while 23.6% of the officers from the Air Force received outpatient treatment at TRICARE civilian providers. Generally, MTFs remained the places most frequented by individuals who sought outpatient treatment for PTSD related illnesses.

c. *Average Treatment Costs*

From the individual perspective, the average outpatient treatment costs for PTSD (and related illnesses) for both the MTFs and the civilian providers were relatively higher than that at the claims level since the individual data files would have had a much smaller base over which to spread the total costs for treatment during all visits to the facilities. For instance, the average outpatient treatment costs for an Army officer between FY2001 and FY2006 was

at \$1,811 at MTFs and \$1,693 at civilian medical providers. The Air Force officers incurred the highest average costs of \$3,513 per person for PTSD related treatment at MTFs only; and the Marine Corps officers incurred the highest average costs of \$2,038 for outpatient treatment at the TRICARE civilian providers, as illustrated in Table 7.4.

Officers (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Depression	59.7	16.6	47.8	21.1	71.4	23.0	26.7	17.3
Substance Abuse	17.9	4.2	21.7	3.8	42.9	6.4	13.3	6.1
Other Psychosis	11.9	2.7	8.7	1.9	14.3	4.8	6.7	4.4
Other Mental Health Illness	17.9	27.6	26.1	30.4	28.6	19.1	26.7	28.1
Unspecified mental and behavioral problems	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
External causes of Injury	1.5	0.2	4.4	0.5	0.0	2.4	0.0	0.7
Other V-code diagnoses (excluding V40)	29.9	19.1	34.8	22.0	28.6	20.6	40.0	18.6
Acute illness (any numerical ICD 9 that is <290 and >319, exclude E and V codes)	46.3	22.6	47.8	19.5	14.3	8.7	66.7	12.9
Count of Mental Health Illness Comorbidity								
0	11.9	57.9	17.4	54.7	0.0	60.3	33.3	56.6
1	68.7	33.7	69.6	35.2	57.1	28.6	60.0	32.9
2	19.4	7.6	8.7	8.4	28.6	8.7	6.7	8.8
>2	0.0	0.7	4.4	1.6	14.3	2.4	0.0	1.7
Count of Acute Illness Comorbidity								
0	38.8	65.5	30.4	65.9	57.1	73.0	13.3	73.2
1	44.8	27.2	52.2	26.6	42.9	22.2	66.7	21.4
2	16.4	7.2	17.4	7.3	0.0	4.8	20.0	5.4
>2	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.0
Visit Site (%)								
MTF	52.2	77.3	52.2	68.3	71.4	71.4	60.0	83.4
TRICARE Providers	41.8	13.9	43.5	23.6	14.3	19.8	33.3	9.5
Both	5.9	8.8	4.4	8.1	14.3	8.8	6.7	7.1
Total Number of Individuals	67	1,202	23	369	7	126	15	295
Average Treatment Costs(\$)								
MTF								
Total Cost	12,954.27	1,811.73	8,787.64	3,513.89	7,027.07	2,189.92	7,323.72	2,608.36

Officers (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Total Pharmacy Cost		124.8518		238.96		197.049		181.05
Number of Individuals	38	1033	13	282	6	99	10	263
TRICARE Providers								
Bill Charged	14,758.03	1,693.13	29,836.63	1,374.96	51,929.56	2,038.61	5,828.20	1,656.44
Bill Allowed	5,914.04	1,105.58	16,723.41	976.04	28,986.40	1,091.00	2,916.50	1,040.79
Number of Individuals	32	273	11	117	2	36	6	49
Length of Stay(Average)	14.34		17.26		14.71		6.87	
Number of Individual Claims	67		23		7		15	

Table 7.4. Overall PTSD Comorbidity Distribution and Average Treatment Costs for Officers Population across Services (Individual Level)

Enlisted Personnel (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Depression	35.3	12.6	46.5	20.1	30.0	16.4	34.2	17.3
Substance Abuse	30.2	10.7	23.1	8.1	39.0	15.2	25.7	12.3
Other Psychosis	10.9	3.4	11.4	3.3	7.8	2.8	7.1	3.7
Other Mental Health Illness	24.9	30.7	26.0	30.0	24.6	27.2	33.5	35.9
Unspecified mental and behavioral problems (V40)	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0
External causes of Injury	3.7	0.5	0.8	0.3	5.4	5.4	4.0	1.5
Other V-code diagnoses (excluding V40)	29.2	22.0	20.1	23.7	51.2	24.3	47.9	20.2
Acute illness (any numerical ICD 9 that is <290 and >319, exclude E and V codes)	46.4	19.3	43.3	15.8	38.8	14.4	41.5	12.8
Count of Mental Health Illness Comorbidity								
0	16.6	54.2	10.5	50.8	15.0	51.6	13.4	44.7
1	66.6	35.7	73.1	38.7	68.9	37.0	73.0	43.3
2	15.5	8.3	15.2	8.7	15.8	9.5	13.4	10.1
>2	1.2	1.7	1.2	1.7	0.3	1.8	0.2	1.9
Count of Acute Illness Comorbidity								
0	40.5	65.6	47.9	67.3	31.0	64.7	33.5	71.4
1	41.2	26.8	40.1	25.6	45.7	26.9	42.6	23.0
2	16.7	7.3	11.7	7.1	20.2	7.9	20.7	5.4
>2	1.6	0.2	0.3	0.1	3.1	0.5	3.1	0.2
Visit Site (%)								
MTF	49.2	84.1	30.4	76.9	78.8	87.2	63.4	90.0
TRICARE Civilian Providers	43.6	9.3	67.3	12.8	18.1	8.2	34.2	5.2
Both	7.1	6.6	2.3	10.3	3.1	4.6	2.5	4.8
Total Number of Individuals	1,806	19,444	342	3,567	387	4,244	448	4,896
Average Treatment Costs(\$)								
MTF								
Total Cost	12,954.27	1,808.88	12,574.90	2,956.76	12,191.85	1,654.84	10,723.06	2,101.21

Enlisted Personnel (in percentage)	Army		Air Force		Marine Corps		Navy	
Mental Health Illness Indicators	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Total Pharmacy Cost		122.4138		176.87		138.0972		138.86
Number of Individuals	996	17,525	112	3,104	317	3,859	295	4,612
TRICARE Civilian Providers								
Bill Charged	11,809.04	1,337.19	12,154.65	1,861.90	12,341.05	1,153.64	9,912.36	1,239.17
Bill Allowed	6,185.78	873.40	5,305.99	1,129.57	6,503.80	684.24	4,628.15	753.35
Number of Individuals	917	3,091	238	824	82	544	164	492
Length of Stay(Average)	13.04		11.49		12.87		10.58	
Number of Individual Claims	1,806		342		387		448	

Table 7.5. Overall PTSD Comorbidity Distribution and Average Treatment Costs for Enlisted Population across Services (Individual level)

2.1 Enlisted PTSD Population – Inpatient Visits (Table 7.5)

Given the operational profiles and mission requirements of the different services, there were a higher number of enlisted personnel (as compared to the officer population) across the services who were admitted for PTSD related treatments at either the MTFs or the TRICARE civilian medical providers as shown in Table 7.5. A total of 1,806 Army enlisted personnel had been admitted during the study period for PTSD related treatment and this was at least four times more than other services. In contrast to evidence in existing literature, it was found that the Navy enlisted personnel (total of 448 of them and 15% more than the Marine Corps) accounted for the next largest group of personnel who had prior admissions for PTSD treatment between FY2001 and FY2006. This would imply that despite different operational profiles between the Navy and the Marine Corps, the Navy enlisted personnel were just as susceptible to PTSD risks as the GWOT continued.

a. Mental Health Illness Indicators

As derived from the data, and shown in Table 7.5, it was found that depression remained the dominant comorbidity associated with PTSD among the enlisted personnel across the services and was the most frequent co-morbidity among inpatient admissions in addition to PTSD. There was a significantly higher percentage of the PTSD enlisted population who also suffered from depression and had been previously admitted to hospitals across the different branches of services. For instance, 46.5% of the Air Force enlisted PTSD population were the largest proportion who were previously admitted for treatment of depression; while nearly 35% of both the Army and Navy enlisted personnel were admitted for depression. Substance abuse and other mental health illnesses were also PTSD comorbidities that had a certain extent of impact on the enlisted PTSD population (as depicted in Table 7.5). The enlisted personnel from the Marine Corps PTSD population had the highest percentage

(39%) among the four services to also be admitted for substance abuse. This finding is in line with the existing literature that enlisted personnel suffering from PTSD were susceptible to substance abuse as well. While it was common for mental health related illness to dominate the PTSD comorbidity distribution pattern, acute illnesses (i.e. non mental health related illnesses) were also found to be one large category of comorbidity that was associated with PTSD, with nearly 40% of the enlisted population across the board being treated for acute illness under inpatient admissions during the study period.

b. Frequency of Site Visits

Similar to the findings for the officer population, it was clear that the majority of the enlisted PTSD population (especially the Army and Navy) were admitted to MTFs for PTSD related treatment between FY2001 and FY2006, with the Marine Corps enlisted personnel accounting for 78.8%, Navy enlisted personnel with 63.4% having prior admissions at MTFs and 49% of the Army enlisted personnel of being admitted into MTFs for PTSD related treatment. Air Force enlisted personnel were reported as having the highest percentage - 67.3% of inpatient admissions at civilian hospitals under TRICARE. Overall, the Army enlisted personnel had the highest percentage (7.1%) of having had prior admissions to both the MTFs and civilian medical providers.

c. Average Treatment Costs and Length of Stay

At the individual level, the Army enlisted personnel incurred the highest average treatment costs of \$12,954 for PTSD and related illness admissions at the MTFs among the enlisted population; the Air Force and Marine Corps enlisted personnel incurred average treatment costs of over \$10,000 per person for being admitted and receiving treatment at MTFs during the same period. The Marine Corps enlisted personnel incurred the highest costs for admissions to TRICARE civilian providers at \$12,341. The average treatment costs could be further explained by the average length of stay at the treatment

facilities (military and civilian) in view of the fact that the longer a period of stay at the treatment facility, the higher the treatment costs. For instance, the average length of stay for enlisted personnel at the treatment facilities across the services was the longest for both the Army and the Marine Corps enlisted personnel at 13 days.

2.2 Enlisted PTSD Population – Outpatient Visits (Refer to Table 7.5)

In contrast to the inpatient records for the enlisted population, records showed many more personnel from the enlisted population seeking outpatient treatment for PTSD related illnesses during the study period as shown in Table 7.5. The Army enlisted population was at the top of the list with 19,444 persons who received outpatient treatment from either the MTFs or the TRICARE civilian providers, while the enlisted personnel from the Navy, totaled 4,896 personnel and ranked second in terms of numbers.

a. Mental Health Illness Indicators

In contrast with the inpatient records for enlisted personnel at the individual level, other mental health illness accounted for more than 30% of the respective enlisted personnel across the services as the dominant comorbidity associated with PTSD outpatient treatment at the military and civilian facilities (except for Marine Corps at 27.2%). Enlisted personnel from the Navy ranked with the highest percentage of 35.9% being treated for other mental illness as compared with the rest of the services. While it could be inferred that there were definitely more personnel responding to outpatient treatment (i.e. medication, rehabilitation and behavioral therapy) for PTSD related comorbidities given the rising trends of PTSD incidences among the active duty service personnel in the GWOT, it was also important to note the substantial numbers among the Navy enlisted personnel who required outpatient treatment for PTSD related comorbidities.

b. Frequency of Site Visits

Based on Table 7.5, it was evident that the majority of the enlisted PTSD population, especially the Marine Corp and the Navy with 87.2% and 90% respectively, had visited only MTFs for PTSD related outpatient treatment between FY2001 and FY2006; while 84.1% of the Army enlisted personnel and 76.9% of the Air Force enlisted personnel visited only MTFs for outpatient treatment. In contrast with the officer population, the enlisted population showed lesser tendency to visit TRICARE civilian providers for their PTSD related outpatient treatment. For example, the percentages for outpatient visits to these providers were generally below 10% across the services for PTSD related treatment. The enlisted personnel from the Air Force had the highest percentage of its population (10.3%) who were treated at both the MTFs and the TRICARE civilian medical providers for PTSD related outpatient treatment.

c. Average Treatment Costs

At the individual level, the Air Force enlisted personnel incurred the highest costs for outpatient treatment at MTFs at \$2,956. For the average treatment costs at the TRICARE civilian medical providers, the enlisted personnel from the Air Force again had the highest costs of \$1,861 per person for PTSD related outpatient treatment. It appeared that the Air Force enlisted personnel had higher rates of outpatient treatment/services rendered for PTSD related treatment as compared to other services. As the outpatient services/treatment for PTSD included mostly rehabilitation and medication, it could be inferred that the severity of PTSD symptoms amongst the Air Force enlisted personnel may have been way below those of the Army or the Marine Corps.

E. ANALYSIS OF DEMOGRAPHICS AT INDIVIDUAL LEVEL – GENDER AND RACE ON THE PTSD COMORBIDITY

This section further extends the discussion of the PTSD comorbidity distribution at the individual level via the demographics of gender (male and female) and race (white and non white).⁵¹ The purpose of this was to assess whether there were potential differences in the PTSD comorbidity distribution and treatment costs for different demographic groups. In addition, only the mental illness comorbidity component between the officer and enlisted population across the services will be evaluated here. This section will also describe the potential differences between the inpatient⁵² and outpatient treatment trends between male and female within the respective officer and enlisted populations across the different branches of services.

1.1 Officers and Warrant Officers PTSD Population – Analysis by Gender (Table 7.6)

a. Inpatient Records

As shown in Table 7.6, depression was the dominant PTSD comorbidity among the officer population, especially amongst the female officers across the services. Compared to the male officers, 64.3% of the female Army officers had prior admissions which were for treatment of depression, and this was significantly higher than female officers of the other services. This could be inferred to mean that female personnel were more likely to succumb to depression given both exogenous (i.e. deployment characteristics, location etc) and endogenous factors (personality, emotion driven). In addition, the difference could also be due to the fact that despite the social stigma associated with

⁵¹ Non white population refers to personnel whose race is Black, Hispanic, Asian or other minority races.

⁵² Inpatient records denote the admission history to either the MTFs or the TRICARE civilian providers, while the outpatient records denote the outpatient treatment received at either the MTFs or the TRICARE civilian providers.

PTSD, females were more willing to seek treatment for PTSD related comorbidity as compared to males.

Based on the data, it was found that female officers were more likely to have at least one comorbidity associated with PTSD. The Air Force male officers had the highest percentage of 69% to have prior inpatient admissions at MTFs only for PTSD related treatment. It was also found that Air Force female officers had the highest percentage (40%) of being admitted for substance abuse treatment. Of the Air Force female officers, 50% too were previously admitted for other mental health illness as compared to the females from the other services. It could be inferred that the MTFs remained the most frequented venue for PTSD related treatment (for both inpatient and outpatient services) across the different branches of service as shown in Table 7.6.

b. Outpatient Records

Under the outpatient treatment profiles, depression remained the most common PTSD related comorbidity among the officer population across the services, with the females at the highest numbers during the study period. For instance, the female officers from the Marine Corp constituted the highest proportion of personnel who sought outpatient treatment for depression problems at either the military or civilian medical facilities as shown in Table 7.6. In terms of substance abuse, the female officers from the Marine Corps, too, showed the highest percentage of 12.5%, who were rendered outpatient treatment.

While both the inpatient and outpatient records showed that most of the PTSD related treatment was conducted at the MTFs, i.e. with over half of the officers population being treated at MTFs only, it was interesting to note that 60% of the female officers from the Air Force actually were admitted at TRICARE civilian providers and 25% of them had visited only the civilian facilities for outpatient treatment. It could be inferred from Table 7.6 that females tend to have more PTSD comorbidities as compared to their male counterparts.

Officers (By Gender)	Army				Air Force				Marine Corps				Navy			
(in percentage)	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Mental Health Illness Indicators (%)	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Depression	56.4	64.3	14	23.9	46	50	14.8	26.9	66.7	100	22	31.3	12.5	42.9	14.4	21.5
Substance Abuse	18.0	17.9	4.5	3.4	7.7	40	3.9	3.6	50	0	5.5	12.5	12.5	14.3	5.75	6.6
Other Psychosis	15.4	7.1	2.2	3.9	7.7	10	2.27	1.5	16.7	0	4.6	6.2	0	14.3	4.0	4.9
Other Mental Health Illness	23.1	10.7	27	28.5	7.7	50	32.4	28.5	33.3	0	19	18.8	37.5	14.3	23	35.5
Unspecified mental and behavioral problems (V40)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Count of Mental Health Illness Comorbidity																
0	10.3	14.3	61	50.6	31	0	58.5	51.3	50	0	62	50	50	14.3	63.8	46.3
1	66.7	71.4	31	39.9	69	70	31.8	38.3	33.3	100	28	31.3	37.5	85.7	27	41.3
2	23.1	14.3	7.3	8.5	0	20	7.9	8.8	16.7	0	7.3	18.8	12.5	0	7.5	10.7
>2	0	0	0.6	0.92	0	10	1.7	1.5	0	0	2.7	0	0	0	1.7	1.6
Number of Individuals	39	28	876	326	13	10	176	193	6	1	110	16	8	7	174	121
Visit Site (%)																
MTF	56.4	46.4	77	78.2	69	30	71.6	65.3	66.6	100	72	68.8	62.5	57.1	82.2	85.1
TRICARE Providers	38.5	46.4	14	13.8	31	60	21.6	25.4	16.7	0	20	18.7	37.5	28.6	10.3	8.3
Both	5.1	7.2	9.1	8	0	10	6.8	9.3	16.7	0	8.2	12.5	0	14.3	7.5	6.6
Total Number of Individuals	67		1,202		23		369		7		126		15		295	

Table 7.6. Overall PTSD Comorbidity Distribution for Officer Population across Services (Individual Level - Gender)

* M= Male
F=Female

1.2 Enlisted PTSD Population - Analysis by Gender (Table 7.7)

a. Inpatient Records

Similar to the officer population, the female enlisted personnel across the different branches of services showed a higher proportion of being admitted for depression problems. Nearly half of the female Air Force enlisted personnel were admitted during the study period for depression, while nearly 39% of the Army female enlisted personnel and 36% of the Navy female enlisted personnel were admitted to either the MTFs or civilian medical providers as illustrated in Table 7.7. In addition, the female enlisted personnel across the services had a higher incidence of being admitted for other mental illness treatment as well. For instance, 37.9% of the Navy female enlisted personnel were admitted to hospitals for other mental health illness problems. On the contrary, the male enlisted personnel across the services accounted for higher percentages than their female counterparts when it came to substance abuse. The Marine Corps enlisted personnel were at the top of the list with over 41% of the Marine Corp enlisted population having prior admissions for substance abuse treatment between FY2001 and FY2006.

b. Outpatient Records

Depression was found to be a major PTSD comorbidity among the outpatient data samples across the services as can be seen in Table 7.7. The female enlisted personnel across the services registered higher percentages of seeking outpatient treatment for depression and other mental health illnesses. The Air Force female enlisted personnel topped the list with nearly 24% of them who sought outpatient treatment for depression at either the military or civilian medical facilities between FY2001 and FY2006. Nearly 40% of the Navy female enlisted personnel actually sought outpatient treatment for other mental health illnesses, outranking the Army or the Marine Corps.

Analogous to the inpatient records for the officers, most of the enlisted personnel (more than 50%) across the services were admitted and sought outpatient treatment at the MTFs only. One of the possible reasons for the MTFs to be the most frequented places by the enlisted personnel could be due to the fact that the treatment costs there may be more affordable compared to the TRICARE civilian providers and the enlisted personnel may feel more at ease seeking treatment at one of the military bases.

Enlisted Personnel (By Gender) (in percentage)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Mental Health Illness Indicators (%)	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Depression	34.2	39	11.67	16.7	41	50.5	16.1	23.5	29	35	15.5	22.3	32.7	36	15.4	20.1
Substance Abuse	33.8	17.9	12	5.36	24	22.2	9.0	7.3	41.4	27	15.9	10.4	30.2	20.2	14.2	9.6
Other Psychosis	11.3	9.3	3.3	3.8	9.5	12.9	2.56	3.8	6.5	14	2.7	3.42	6.12	8.4	3.3	4.0
Other Mental Health Illness	21.5	36.5	29.9	33.67	25	26.8	27.8	31.8	22.5	35	26.6	30.8	29.8	37.9	33.1	39.8
Unspecified mental and behavioral problems (V40)	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0
Count of Mental Health Illness Comorbidity																
0	18.7	9.8	55.1	50.7	14	8.2	54.7	47.5	16.4	7.9	52.2	47.5	15.5	10.8	48.2	39.8
1	63.2	78.4	34.6	40.2	73	73.2	36.6	40.6	67.9	75	36.6	39.6	70.2	76.4	39.8	48.2
2	16.8	11	8.41	7.9	14	16.5	7.3	9.8	15.7	16	9.2	11.5	14.3	12.3	10.1	10.1
>2	1.3	0.7	1.77	1.15	0.00	2.1	1.3	2.0	0	1.6	1.9	1.44	0	0.5	2	1.7
Number of Individuals	1,398	408	15,711	3,733	148	194	1,643	1,924	324	63	3,688	556	245	203	2,853	2,043
Visit Site (%)																
MTF	46.7	57.6	83.6	86.4	27	33	77.9	76.0	77.5	86.0	86.6	91.2	62	65	89.6	90.5
TRICARE Providers	45.9	35.5	9.4	8.8	72	64	12.3	13.2	19.7	9.5	8.6	5.6	34.7	33.5	5.7	4.5
Both	7.2	6.9	7	4.8	1.4	3.0	9.8	10.8	2.8	4.8	4.8	3.2	3.3	1.5	4.7	5
Total Number of Individuals	1,806		19,444		342		3,567		387		4,244		448		4,896	

Table 7.7. Overall PTSD Comorbidity Distribution for Enlisted Population across Services (Individual level- Gender)

* M= Male
F=Female

2.1 Officers and Warrant Officers PTSD Population – Analysis by Race (Table 7.8)

a. Inpatient Records

As illustrated in Table 7.8, depression appeared to be the common PTSD comorbidity among the white officers population across the services, with the white officers from the Army and the Marine Corps⁵³ having over 60% of their population being admitted to either military or civilian treatment facilities between FY2001 and FY2006. Based on the clinical data, it was also observed that 52% of the white officers from the Air Force suffered from depression and had been admitted during the study period as well, while the Navy officers constituted 30%. This clinical information on the Air Force and Navy's PTSD population would be useful in providing some insights into the overall PTSD situation in view of the few or no statistics on those two services' PTSD portfolios. In addition to this, substance abuse was the other PTSD comorbidity which saw many of the white officers being admitted for treatment. For instance, 50% of the white Marine Corps officers and 23% of both the Army and Air Force officers had been admitted between FY2001 and FY2006 for substance abuse.

Other mental health illness seemed to be the most common PTSD comorbidity among the non white officer population across the services, with 40% of Navy non white officers being admitted for PTSD treatment as compared to their white counterparts. The Army and Air Force non white officer population, who were also admitted for other mental health illness as PTSD comorbidity, only accounted for 36.8% and 33.3% respectively as shown in Table 7.8.

As illustrated in Table 7.8, Air Force officers have the highest percentage (76.5%) of having one mental illness comorbidity among the white

⁵³ As there was only one non white officer within the Marine Corp PTSD population in the sample, the admission incidence for the depression comorbidity for this individual should be taken as an exception and not affect the analysis for the white officers.

officers population who were admitted for PTSD related treatment; while the Army non white officers had the highest percentage (73.7%) in the same category.

There was a larger proportion of the non white officers from the Services who were admitted at only MTFs for PTSD related treatment. The Navy had the highest percentage (80%) of its non white officers who had admissions only at the MTFs for their PTSD related treatment; while the white officers from the Marine Corps had the highest percentage (66.7%) of personnel who had prior MTF admissions during the study period.

b. Outpatient Records

In outpatient records, the trend seemed to be reversed as there were higher percentages of non white officers from the services (except Navy) being treated for depression as PTSD comorbidity compared to the white officers. The Marine Corps non white officers had the highest percentage of 27% of its PTSD population seeking outpatient treatment for depression either at the MTFs or the TRICARE civilian providers. For the other mental health illness comorbidity, the white officers seemed to constitute higher percentages of those being rendered outpatient treatment with the Air Force officers comprising 30% and the Navy officers being 28.7%.

As highlighted in Table 7.8, the majority of the officers (more than 55% of respective populations regardless of race) who had undergone outpatient treatment had no mental illness comorbidity. From the perspective of the visit sites, it could be seen that most of the non white population from the different branches of services had only visited the MTFs for PTSD related outpatient treatment. Navy non white officers were at the top of the list with 83% of the white officers and 84.5% of the non white officers who consulted only the MTFs for treatment.

2.2 Enlisted PTSD Population – Analysis by Race (Table 7.9)

a. Inpatient Records

As indicated in Table 7.9, the enlisted population from the Air Force showed the highest proportion of both the white (44.7%) and the non white population (51%) with depression as the most common PTSD comorbidity under an inpatient setting. On the other hand, the enlisted population from the Marine Corp demonstrated the highest percentage of personnel – white (41.1%) and non-white (34.2%), having substance abuse as a PTSD comorbidity and admitted into either the MTFs or the TRICARE civilian providers between FY2001 and FY2006.

Consistent with the previous findings, the majority of the enlisted population across the services had one count of mental illness comorbidity and prior admissions during the study period. Notably, 81% of the non white enlisted personnel from the Air Force were found to have one mental illness comorbidity during the study period, while 74% of the white enlisted personnel from the Navy formed the highest proportion of the whites to have one mental illness comorbidity.

Similar to the officer population, the non white enlisted personnel from the different services accounted for relatively higher proportion to have only sought outpatient treatment at either MTFs or the TRICARE civilian providers as compared to their white counterparts. Among them, 84.6% of the Marine Corps non white enlisted personnel went only to the MTF for outpatient treatment of the PTSD related comorbidity and Army non white enlisted personnel accounted for 55.8%. As depicted in Table 7.9, it was presented that enlisted personnel from the Air Force had higher incidences for both the white (67.9%) and non white (66%) for inpatient admissions into TRICARE civilian providers only as compared to the MTFs.

b. Outpatient Records

As indicated in Table 7.9, it was found that other mental health illness was the most common PTSD comorbidity with more than one-third of the enlisted personnel from the different services seeking outpatient treatment at either the military or the civilian treatment facilities. A result was that both the white and non white enlisted personnel from the Navy (36.5% and 35% respectively) contributed to the highest percentage of personnel who were also seeking outpatient treatment for other mental illness comorbidity; while the Army enlisted personnel came close to about 31% for both distinct groups.

Similar to the inpatient records, the majority of the enlisted population across the services had one count of mental illness comorbidity for outpatient treatment during the study period. Notably, the Navy enlisted personnel – both white and non white personnel – were 43% and 44% respectively.

Similar to the officer population, the non white enlisted personnel from the different services accounted for a relatively higher proportion to have only sought outpatient treatment at either MTFs or the TRICARE civilian providers as compared to their white counterparts. Among them, 91.4% of the Navy non white enlisted personnel went only to the MTF for outpatient treatment of the PTSD related comorbidity. The Marine Corps non white enlisted personnel accounted for 89.1%. As depicted in Table 7.9, the enlisted personnel from the Air Force had higher incidences for both the white (67.9%) and non white (66%) for inpatient admissions into TRICARE civilian providers only as compared to the MTFs.

Officers (By Race) (in percentage)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Mental Health Illness Indicators (%)	W	NW	W	NW	W	NW	W	NW	W	NW	W	NW	W	NW	W	NW
Depression	60.4	57.9	15.6	18.9	52.9	33	20	25	66.7	100	22.5	27	30	20	19	10.3
Substance Abuse	22.9	5.26	4.75	2.65	23.5	17	3.8	3.7	50	0	6.31	6.7	10	20	5.91	6.9
Other Psychosis	14.6	5.26	3.01	1.77	0	33	2.1	1.2	16.7	0	5.41	0	0	20	4.64	3.45
Other Mental Health Illness	10.4	36.8	28.4	25.7	23.5	33	31	30	33.3	0	19.8	13	20	40	28.7	25.9
Unspecified mental & behavioral problems (V40)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Count of Mental Health Illness Comorbidity																
0	12.5	10.5	57.6	59	11.8	33	55	53	0	0	59.5	67	40	20	55.7	60.3
1	66.7	73.7	33.8	33.3	76.5	50	35	35	50	100	29.7	20	60	20	32.5	34.5
2	20.8	15.8	7.76	7.37	11.8	0	7.3	12	33.3	0	8.11	13	0	20	10.1	3.45
>2	0	0	0.81	0.29	0	17	2.1	0	16.7	0	2.7	0	0	0	1.69	1.72
Number of Individuals	48	19	863	339	17	6	288	81	6	1	111	15	10	5	237	58
Visit Site (%)																
MTF	50	57.9	75.4	82	47.1	67	66	75	66.7	100	71.2	73	50	80	83.1	84.5
TRICARE Providers	43.7	36.8	15.2	10.6	47.1	33	26	16	16.7	0	19.8	20	40	20	10.1	6.9
Both	6.3	5.3	9.4	7.4	5.8	0	8	8.6	16.6	0	9	6.7	10	0	6.8	8.6
Total Number of Individuals	67		1,202		23		369		7		126		15		295	

Table 7.8. Overall PTSD Comorbidity Distribution for Officers Population across Services (Individual Level – Race)

* W=White population

NW= Non White population (includes Black, Hispanic, Asian or other races)

Enlisted Personnel (By Race) (in percentage)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Mental Health Illness Indicators (%)	W	NW	W	NW	W	NW	W	NW	W	NW	W	NW	W	NW	W	NW
Depression	34.2	37.4	11.91	14.02	44.7	51	19.81	21	28.5	33.3	16.31	16.5	33	35	17.3	17.4
Substance Abuse	31.6	27.5	11.73	8.8	25.2	18	8.59	6.7	41.1	34.2	15.81	13.6	26	25	12.5	12
Other Psychosis	11.4	9.72	3.55	3.1	11.8	10	3.32	3.1	6.67	10.3	2.81	2.63	7.6	6.4	4	3.09
Other Mental Health Illness	26	22.8	31.26	29.57	24.4	30	30.38	29	23	28.2	28.03	25.1	33	35	36.5	34.9
Unspecified mental and behavioral problems (V40)	0.00	0	0.06	0.1	0.00	0	0	0.1	0	0	0.13	0	0	0	0.03	0.05
Count of Mental Health Illness Comorbidity																
0	15.3	19.4	53.53	55.75	12.6	5.2	50.53	52	15.9	12.8	50.58	54.3	13	14	44.4	45.2
1	67.2	65.5	36.35	34.58	69.9	81	38.7	39	68.9	69.2	37.74	35.3	74	72	42.8	44.2
2	16.5	13.4	8.41	8.15	16.3	13	8.93	8.1	15.2	17.1	9.81	8.64	13	14	10.9	8.72
>2	0.99	1.68	1.72	1.52	1.22	1	1.83	1.4	0	0.85	1.88	1.73	0	0.6	1.87	1.95
Number of Individuals	1,209	597	12,741	6,703	246	96	2,620	947	270	117	3,029	1,215	275	173	3,050	1,846
Visit Site (%)																
MTF	46	55.8	82.5	87.1	30.1	31	75.1	82	76.3	84.6	86.4	89.1	62	66	89.1	91.4
TRICARE Providers	47.3	36.2	10.4	7.3	67.9	66	13.8	10	20	13.7	8.9	6.6	36	32	5.4	4.9
Both	6.7	8	7.1	5.5	2	3.1	11.1	8.2	3.7	1.7	4.7	4.3	2.6	2.3	5.5	3.7
Total Number of Individuals	1,806		19,444		342		3,567		387		4,244		448		4,896	

Table 7.9. Overall PTSD Comorbidity Distribution for Enlisted Population across Services (Individual Level – Race)

* W=White population

NW= Non White population (includes Black, Hispanic, Asian or other races)

F. ANALYSIS OF DEMOGRAPHICS AT INDIVIDUAL LEVEL – GENDER AND RACE ON THE TREATMENT COSTS AND LENGTH OF STAY

This section will examine the treatment cost patterns and the average length of stay (inpatient admissions) at the individual level across the different branches of services via gender and race. The purpose of this section is to present the extent of the costs incurred for PTSD related inpatient and outpatient treatment either at the MTFs or the TRICARE civilian providers, as well as to assess the pattern of demographics having any length of stay. This analysis will be divided into officers and enlisted PTSD population across the different branches of services based on gender and race.

Generally, it could be seen that the average PTSD treatment costs per person for inpatient admissions and treatment were much higher than those of outpatient treatment at both the MTFs as well as the TRICARE civilian providers, in view of the differences in the complexity of the medical procedures between the two types of treatment. Under the TRICARE system, the personnel were eligible for medical claims based on the TRICARE option plans they were enrolled in as depicted by the “bill allow” variable. In this section, the study will concentrate only on the treatment costs for PTSD and related illnesses to identify possible trends between different demographic characteristics.

1. Average Treatment Costs and Length of Stay for Officers and Warrant Officers PTSD Population – by Gender (Table 7.10)

As illustrated in Table 7.10, the average treatment costs for inpatient PTSD admissions at the MTFs for male officers were higher than their female counterparts (with the exception of the Navy). The average PTSD treatment costs for a typical admission to a MTF for an Army male officer amounted to \$12,642 as compared to the female counterpart at \$12,048; while a male officer from the Marine Corps would incur an average of \$8,160 for similar admissions.

Comparatively speaking, the female officer from the Army incurred the highest inpatient treatment costs at \$12,048 when compared to the female officers from the other services.

Taking into account the inpatient treatments at the TRICARE civilian providers, it was found that the average costs for inpatient admissions were generally more expensive as compared to the MTFs. Female officers across the services incurred higher costs when admitted to these facilities (with the exception of the Marine Corp as there was only one female officer who was admitted to MTF for PTSD related treatment) when compared with their male counterparts. For instance, compared with the other services, the female officer from the Air Force had the highest average treatment costs of \$43,419 for inpatient admissions between FY2001 and FY2006, while the Army female officers incurred \$15,740 on average for civilian admissions. For the male officers, the Marine Corps officers showed the highest average costs at civilian admissions of \$51,929 during the same period.

Consistent with the expensive inpatient treatment costs, the average length of hospital stay would be positively related. As illustrated in Table 7.10, the female officers from the Air Force had the longest average length of stay of 30.8 days at either the MTF or civilian treatment facilities as compared with the officer population. The male officers from the Marine Corps, on the other hand, showed the longest duration of inpatient stay – 17 days when compared with the male officer population from the different services.

From the outpatient treatment costs at the MTFs, it could be seen that the female officers from the services incurred higher average costs than their male counterparts. For instance, the female officers from the Air Force incurred the highest outpatient costs of \$4,181; while the female officers from the Marine Corps had average costs of \$3,054 during the same period. At the TRICARE civilian providers, the female officers from the Army had the highest outpatient costs of \$2,767; and the male officers from the Marine Corps the highest at \$2,186.

Overall, the male and female officers from the Army incurred the highest amount of inpatient treatment costs at the MTFs; while the female officers from the Air Force incurred the highest amount for the inpatient treatment at the TRICARE civilian providers. The male officers from the Marine Corps, too, incurred the highest amount of treatment costs regarding TRICARE civilian providers. The female officers from the services (except for Marine Corps) showed the tendency to have longer a length of stay at the treatment facilities as compared to their male counterparts.

Officers (By Gender)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Average Cost (\$)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
MTF																
Total Cost	12,642.9	12,048.6	1,744.7	1,991.1	9,058.7	8,177.7	2,817.4	4,181.4	8,160.4	1,360.3	2,059.2	3,054.8	6,107.9	8,539.6	2,368.1	2,942.6
Total Pharmacy Cost			125.5	123.0			197.3	278.9			186.6	267.8			168.4	198.9
Number of Individuals	24	14	752	281	9	4	138	144	5	1	86	13	5	5	153	110
TRICARE Providers																
Bill Charged	13,891.5	15,740.1	1,315.4	2,767.9	6,066.9	43,419.4	1,391.2	1,362.9	51,929.6	0.0	2,186.8	1,119.8	3,901.2	7,755.2	1,254.7	2,348.3
Bill Allowed	5,653.9	6,208.9	855.8	1,816.3	1,970.0	25,153.9	995.3	961.7	28,986.4	0.0	1,172.0	588.7	1,693.4	4,139.6	816.0	1,427.9
Number of Individuals	17	15	202	71	4	7	50	67	2	0	31	5	3	3	31	18
Length of Stay(Av.)	13.62	15.36			6.85	30.80			17.00	1.00			4.75	9.29		
Number of Claims	39	28			13	10			6	1			8	7		

Table 7.10. Average PTSD Treatment Costs among Officer Population across Services (Gender)

* M= Male
F=Female

2. Average Treatment Costs and Length of Stay for Enlisted PTSD Population – by Gender (Table 7.11)

As indicated in Table 7.11, the male enlisted personnel from the Air Force had the highest inpatient treatment costs - \$15,441 for PTSD related admissions at the MTFs while the Army male enlisted personnel incurred costs of \$13,920 during the study period. In contrast, the female enlisted personnel from the Marine Corps and the Navy incurred higher inpatient admission costs at the MTFs as compared to their male counterparts, accounting for \$13,436 and \$11,682 respectively.

Based on records from TRICARE civilian providers, the male enlisted personnel from the Marine Corps appeared to have the highest inpatient treatment costs of \$12,901 as compared to the male officers from the other services, while the female enlisted personnel from the Air Force had the highest treatment costs from inpatient treatment at the TRICARE civilian providers at \$11,671. Proportionally, with the high inpatient treatment costs, both male and female enlisted personnel from the Marine Corps experienced the longest average length of stay at 12.56 and 14.46 days respectively as shown in Table 7.11.

The outpatient treatment costs at the MTFs for the male enlisted population showed the highest amount being incurred by the Air Force male enlisted personnel, with an average cost of \$2,786, followed by the Navy male enlisted personnel at \$2,168. Similarly, for the female population, the Air Force female enlisted personnel had the highest amount of treatment costs of \$3,101 as compared to the rest of the services. Also, for the outpatient treatment at the TRICARE civilian providers, the Air Force enlisted personnel incurred the highest amounts of \$1,566 and \$2,094 for the male and female enlisted personnel respectively.

Overall, it was surprising to note that Air Force male enlisted personnel had the highest inpatient and outpatient treatment costs at the MTFs when

compared to the rest of the services, especially the Army. In addition, a point worth noting was the fact that the female enlisted personnel from the Air Force, too, incurred the highest amount for outpatient treatment at the MTFs. The male enlisted personnel from the Marine Corps incurred the highest costs for the outpatient treatment at the TRICARE civilian providers instead. While on the whole, both the Army and the Marine Corps enlisted personnel incurred substantial amount for the treatment costs of PTSD related illnesses during the study period, it was important to also note the rising costs that were incurred by both the Air Force and the Navy personnel.

Enlisted Personnel (By Gender)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Average Cost (\$)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
MTF																
Total Cost	13,920.1	10,205.9	1,843.9	1,662.3	15,441.3	10,855.1	2,786.3	3,103.7	11,919.1	13,436.1	1,615.9	1,902.8	9,913.9	11,682.1	2,168.0	2,009.3
Total Pharmacy Cost			128.9	95.4			170.4	182.5			135.2	156.7			153.5	118.7
Number of Individuals	737	259	14,148	3,377	42	70	1,437	1,667	260	57	3,335	524	160	135	2,674	1,944
TRICARE Providers																
Bill Charged	12,156.9	10,312.9	1,346.2	1,291.3	12,736.5	11,671.3	1,566.0	2,094.9	12,901.5	7,795.5	1,170.3	985.2	10,066.9	9,710.0	1,130.3	1,406.3
Bill Allowed	6,430.3	5,134.3	873.4	873.4	5,396.7	5,230.6	970.4	1,254.9	6,842.1	3,759.9	686.8	658.1	5,078.5	4,038.2	684.0	859.9
Number of Individuals	744	173	2,584	507	108	130	363	461	73	9	495	49	93	71	298	194
Length of Stay(Av.)	11.46	11.46			12.04	11.06			12.56	14.46			9.88	11.42		
Number of Claims	1398	408			148	194			324	63			245	203		

Table 7.11. Average PTSD Treatment Costs among Enlisted Population across Services (Gender)

* M= Male
F=Female

3. Average Treatment Costs and Length of Stay for Officers and Warrant Officers PTSD Population – by Race (Table 7.12)

As illustrated in Table 7.12, the Army officers incurred the highest costs for inpatient admissions at \$11,313 for the white officers and \$14,829 for the non white officers. At the TRICARE civilian providers, the Air Force non white officers accounted for the highest inpatient treatment costs at \$117,622 while the Army white officers incurred the highest amount across the white officers' population from the services at \$17,456 between FY2001 and FY2006.

The average length of stay for the white officers from the Army was the longest at 16.15 days as compared to the other services while the male officers from the Marine Corps showed a length of 15.17 days. The length of stay for the non white officers from the Air Force was the longest at 45.33 days on average. This could be due to the fact that there was only a small sample size from the non white officers from the Air Force, but nevertheless, the overall proportion was still worth attention.

The outpatient treatment costs at the MTFs for both the white officers and the non white officers from the Air Force showed the highest amount of \$3,869 and \$2,395 respectively. At the TRICARE civilian providers' level, the outpatient treatment costs for the white officers from the Marine Corps was the highest at \$2,257; while the outpatient costs for the non white officers from the Army were the highest at \$1,171.

Overall, there was evident information that the white officers from the Army had incurred substantial amount of inpatient treatment costs at the MTFs while the non white officers from the Air Force chalked up the highest amount for the inpatient treatment at the TRICARE civilian providers. This was further exemplified by the fact that the average length of stay for the two groups of personnel from the Army and Air Force was also the longest as compared to the rest of the services.

Officers (Race)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Average Cost (\$)	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W
MTF																
Total Cost	11,313.8	14,829.4	1,805.3	1,827.3	6,862.9	13,118.4	3,869.1	2,395.9	6,458.9	9,867.8	2,207.1	2,065.4	8,281.8	5,886.6	2,757.2	1,989.8
Total Pharmacy Cost			126.3	121.3			269.6	142.4			200.7	170.2			185.9	162.0
Number of claims	26	12	730	303	9	4	214	68	5	0	87	12	6	4	212	51
Overall Total	38		1,033		13		282		5		99		10		263	
TRICARE Providers																
Bill Charged	17,456.8	6,661.9	1,843.2	1,171.4	10,328.7	117,622.5	1,438.9	1,064.8	51,929.6	0.0	2,257.2	290.0	6,633.9	1,799.6	1,818.9	934.5
Bill Allowed	6,937.0	2,845.1	1,234.6	657.0	4,692.8	70,861.2	1,014.7	788.6	28,986.4	0.0	1,206.0	170.7	3,176.5	1,616.5	1,149.5	557.5
Number of claims	24	8	212	61	9	2	97	20	2	1	32	4	5	1	40	9
Overall Total	32		273		11		117		3		36		6		49	
Length of Stay(Average)	16.15	9.79			7.35	45.33			15.17	12			7.8	5		
Number of Claims	48	19			17	6			6	1			10	5		

Table 7.12. Average PTSD Treatment Costs among Officers Population across Services (Race)

* W=White population

NW= Non White population (includes Black, Hispanic, Asian or other races)

4. Average Treatment Costs and Length of Stay for Enlisted PTSD Population – by Race (Table 7.13)

As illustrated in Table 7.13, the Army enlisted personnel (both the whites and the non whites) showed the highest average amount of inpatient treatment costs at the MTFs at \$12,575 and \$13,582 respectively; followed by the white enlisted personnel from the Air Force at \$12,393 and the non white enlisted personnel from the Marine Corps at \$13,570 during the same time frame of FY2001 to FY2006. Both the Army and the Marine Corps enlisted personnel experienced the longest duration of stay for inpatient admissions for the white enlisted personnel at 12.64 days and 15.5 days for the non white enlisted personnel respectively.

The white enlisted personnel from the Air Force incurred the highest costs for inpatient stay at the TRICARE civilian providers at \$13,018; while the Army non white enlisted personnel had the highest treatment costs at \$12,300. On the whole there seemed to be a trend toward non white enlisted personnel having a longer duration of hospitalization as compared to the white enlisted personnel (except for the Air Force enlisted personnel who had a similar 11 days of stay on average). This could be attributed to the fact that the enlisted personnel were usually the frontline troops during combat and were more likely to be exposed to PTSD risks as compared to the officers.

In terms of outpatient treatment costs, both the white and non white enlisted personnel from the Air Force remained the highest users of medical services rendered at the MTFs and TRICARE civilian providers for PTSD and related illness. At the MTFs, the white and non white enlisted personnel from the Air Force incurred \$3,044 and \$2,723 respectively; while at the civilian providers, the white and the non white enlisted personnel incurred costs of \$1,900 and \$1,715 respectively.

Enlisted Personnel (Race)	Army				Air Force				Marine Corps				Navy			
	Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient		Inpatient		Outpatient	
Average Cost (\$)	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W	White	Non W
MTF																
Total Cost	12,575.0	13,582.3	1,750.4	1,916.3	12,393.3	13,009.6	3,044.7	2,723.1	11,547.3	13,570.4	1,652.4	1,660.8	10,575.7	10,944.1	2,162.6	2,000.4
Total Pharmacy Cost			121.4	124.3			185.2	154.8			141.3	130.4			144.3	129.9
Number of Claims	621	375	11343	6182	79	33	2255	849	216	101	2736	1123	177	118	2870	1748
Overall Total	996		17525		112		3104		317		3859		295		4618	
TRICARE Providers																
Bill Charged	11,610.5	12,300.1	1,342.1	1,324.4	13,018.0	9,904.6	1,900.5	1,715.4	12,664.7	11,190.2	1,118.2	1,264.4	8,906.1	11,703.2	1,309.1	1,092.7
Bill Allowed	6,262.8	5,995.2	864.0	897.8	5,227.3	5,510.9	1,099.6	1,243.4	5,457.7	10,223.2	699.2	637.7	4,714.5	4,474.5	803.2	649.0
Number of Claims	653	264	2,228	863	172	66	652	172	64	18	412	132	105	59	333	159
Overall Total	917		3,091		238		824		82		544		164		492	
Length of Stay(Average)	12.6	13.8			11.7	11.0			11.7	15.5			10.1	11.3		
Number of Claims	1,209	597			246	96			270	117			275	173		

Table 7.13. Average PTSD Treatment Costs among Enlisted Population across Services (Race)

* W=White population

NW= Non White population (includes Black, Hispanic, Asian or other races)

G. SUMMARY

Depression and substance abuse remained the most common PTSD comorbidity amongst the PTSD population from the different branches of services. As gathered from information in the TRICARE data files, it could be concluded that while at least half of the PTSD diagnosed population across the services had only PTSD (ICD-9 CM code 30981) to contend with, there remained at least a third of the population who had been diagnosed with at least one mental health illness comorbidity between FY2001 and FY2006.

As depicted in the clinical data samples from TRICARE, it was evident there was a significantly large proportion of the enlisted personnel from the Air Force and the Navy who had been diagnosed with similar PTSD comorbidity (i.e. depression and other mental health illness) as their Army and Marine Corps counterparts. This may imply that personnel from these two services could suffer from the same comorbidity associated with PTSD (depression) even though they could have distinctly different operational profiles as compared with the Army or the Marine Corps. In addition, this could be attributable to the fact that the enlisted personnel were much more likely to develop severe PTSD symptoms as compared to the officers, given their close proximity to combat threats and line of fire during their missions.

At the individual level analysis, it was found that female active duty personnel across the services tended to have more PTSD comorbidities and tended to be admitted for a longer period at the treatment facilities as compared to their male counterparts. The male officers from the Army and Air Force incurred higher inpatient treatment costs at the MTFs as compared to the rest of the services; while the female enlisted personnel from the Marine Corps and the Navy incurred higher inpatient treatment costs at the MTFs. The Air Force active duty personnel seemed to have the highest treatment costs at the TRICARE civilian providers.

Generally, while the findings in this section highlighted similar evidence on the PTSD characteristics for Army and Marine Corps personnel, they also provided useful perspectives on the little known statistics among the PTSD diagnosed population from the Air Force and the Navy. Contrary to common expectations, the active duty personnel from the Air Force and Navy were equally susceptible to PTSD risks when they were deployed overseas, especially in the combat regions of Iraq and Afghanistan. Given the substantial treatment costs incurred by all PTSD diagnosed active duty personnel during the study period, it is important for the military planners to note the budgetary implications as the numbers of PTSD cases most likely are on a rising trend in view of the continuation of the GWOT.

VIII. CONCLUSION

A. CONCLUSIONS

Consistent with existing literature on PTSD prevalence among active duty service personnel of the U.S military, the officers and enlisted personnel from the Army and the Marine Corps remained as the largest group of personnel who were highly susceptible to PTSD risks in view of their combat missions and operational deployment profiles. This thesis utilized the clinical and deployment information from both TRICARE and DMDC to conduct a comprehensive study on PTSD prevalence rates across the four services of the U.S. military as well as the potential deployment effects on the probability of being diagnosed with PTSD among active duty service personnel who were deployed overseas. In addition, this study also analyzed the PTSD comorbidity distribution and treatment cost patterns across the services between FY2001 and FY2006.

As described in Chapter V, there was an increasing trend in the number of new PTSD cases across the services between FY2001 and FY2006 as the GWOT continued. The sustained duration of OIF and OEF seemed to have exacerbated the toll on the deployed soldiers of the U.S. military as the statistics for PTSD continued to climb. By analyzing the different study population based on TRICARE enrollments and deployment history, we found that the enlisted population from the Army and the Marine Corps remained highly susceptible to PTSD risks, in view of their combat deployments especially in Iraq and Afghanistan. In addition, there was clear evidence that the PTSD statistics for the Air Force and particularly the Navy were also rising even though their operational roles and combat deployments may be vastly different from those of the Army and the Marine Corps. This information clearly bridged the existing gap of the little to no information on PTSD trends amongst the active duty service personnel from the Air Force and the Navy. The analysis on the PTSD prevalence rate done via separation of the data samples into the officer and enlisted PTSD

population further provided insight into the potential differences in the characteristics of the two populations. Consistent with existing literature, the enlisted personnel, especially from the Army and the Marine Corps, showed increased risk of PTSD if they were ever deployed to Iraq or Afghanistan.

The multivariate analyses showed that deployment characteristics, i.e., deployment location, deployment duration and frequency of deployment, had substantial impacts on the probability of being diagnosed with PTSD among the active duty service personnel between FY2001 and FY2006. Overseas deployments, particularly deployments to Iraq, increased the probability of being diagnosed with PTSD. As their deployment duration and frequency of deployments increased, the probability of the personnel being diagnosed with PTSD also increased. Consistent with the trend analysis and existing literature, the adverse effect of overseas deployment on the probability of being diagnosed with PTSD was found to be more significant on the enlisted personnel, than on the officers. In addition, the multivariate analyses also revealed that enlisted sailors were equally, if not more, affected by the overseas deployments, than the enlisted soldiers in the Army and Marine Corps between FY2001 to FY2006.

Depression and substance abuse remained the most common PTSD comorbidity amongst the PTSD population from the different services. As depicted in the clinical data samples from TRICARE, it was evident there was a significantly large proportion of the enlisted personnel from the Air Force and the Navy who had been diagnosed with similar PTSD comorbidity (i.e. depression and other mental health illness) as their Army and Marine Corps counterparts. This may imply that active duty service personnel from the Air Force and Navy were equally susceptible to PTSD risks when they were deployed overseas, especially in the combat regions of Iraq and Afghanistan. In addition, consistent with the prevailing PTSD literature, enlisted personnel were much more likely to develop severe PTSD symptoms as compared to officers, given their close proximity to the combat threats and line of fire during their missions.

At the individual level analysis, it was found that the female active duty personnel across the services tended to have more PTSD comorbidity and tended to be admitted for a longer period at treatment facilities as compared to their male counterparts. The male officers from the Army and Air Force incurred higher inpatient treatment costs at the MTFs as compared to the rest of the services, while female enlisted personnel from the Marine Corps and the Navy incurred higher inpatient treatment costs at the MTFs only. The Air Force active duty personnel were found to have incurred the highest treatment costs at the TRICARE civilian providers. This could be due to either the Air Force personnel having complex PTSD related symptoms which required specialized professional medical advice, or that they preferred to seek treatment out of the military settings to minimize inadvertent reminders of combat trauma. Given the substantial treatment costs incurred by all PTSD diagnosed active duty personnel during the study period, it is important for the military planners to note the budgetary implications as the numbers of PTSD cases are on the rise in view of the continuation of GWOT.

B. LIMITATIONS OF STUDY

Several limitations of the study deserve comment. First, there is a need to note the two data restrictions and their possible impact on this study. The omission of observations missing EDIPN from the DEERS data set used for the study may have affected the precision of the analysis given the large standard errors present in the frequency distribution of the data. In addition, the restriction on the availability of the deployment data by DMDC, may have rendered a less precise outcome of the multivariate analyses on the impact of deployment characteristics on PTSD occurrences among the deployed troops.

Besides data restrictions, the study was also limited by the fact that only the clinical information from TRICARE was used to provide details on the PTSD population, i.e. only those who had sought medical treatment were considered in the data samples for analysis. While having this data could have provided useful

information on PTSD comorbidity and treatment costs amongst the affected personnel across the services, it greatly reduced the sample size of the PTSD population for a holistic evaluation. The data used in this thesis would not have captured those personnel who did not seek treatment for their PTSD symptoms.

A possible area for improvement may be the use of different regression methods to estimate the deployment effects on the probability of being diagnosed with PTSD amongst the active duty service personnel. Although the probit regression is a widely used tool for the analytical purposes of medical evaluations and its results can be easily interpreted, the probit model could have understated the deployment effects due to the small magnitudes of its coefficient estimates and the low baseline PTSD prevalence rate in our sample. A multinomial logistic regression methodology may be a better approach as the odds ratio terminology and the logit regression would have presented a much more realistic picture for the effects of deployment on PTSD risks.

C. RECOMMENDATIONS

This study has provided detailed PTSD information on the four armed services of the U.S. military between FY2001 and FY2006, especially for the Air Force and the Navy. In view of the rising trends of PTSD across the services and the deployment effects on the probability of being diagnosed with PTSD amongst active duty service personnel, the military planners would do well to make use of the information to review and evaluate the deployment lengths, especially for those “high risk” combat zones. Educational programs should also be used to create awareness among active duty personnel to understand and identify the symptoms for PTSD. In addition, active duty personnel who are returning from their combat tours should be encouraged to seek treatment early for PTSD symptoms. It is important to keep in mind that all service members are involved in the GWOT. An early diagnosis and treatment of PTSD would help to maintain the combat readiness of the U.S. military, as well as reduce the budgetary and social cost of PTSD.

LIST OF REFERENCES

- American Psychiatric Association (2000). Diagnostic and Statistical Manual of Mental Disorders DSM-IV (Text Revision).
- Bisson, J. (2007). Clinical Review: Post-traumatic stress disorder. *British Medical Journal* 2007; 334: 789-793.
- Congressional Budget Office (2007). *Projecting the Costs to Care for Veterans of U.S. Military Operations in Iraq and Afghanistan*. Washington D.C.
- Eibner, C., Ringel, J. S., Kilmer, B., Pacula, R. L. and DiazTerri, C. (2008). The Cost of Post-Deployment Mental Health and Cognitive Conditions. In Tanielian, T. & Jaycox, L. H. (Eds.), *Invisible Wounds of War: Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 169-241). RAND Corporation.
- Erbes, C. (2007). Post-Traumatic Stress Disorder and Service Utilization in a Sample of Service Members from Iraq and Afghanistan. *Military Medicine*, 172(4) 359.
- Grieger, T.A., Cozza S.J., Ursano, R. J., Hoge, C., Martinez, P.E., Engel, C.C., & Wain, H.J., 2006. Posttraumatic stress disorder and depression in battle-injured soldiers. *American Journal of Psychiatry*, 163, pp. 1777-1783.
- Hoge, C. W., Terhakopian, A., Castro, C. A., Messer, S. C., and Engel, C.C. (2007). Association of posttraumatic stress disorder with somatic symptoms, health care visits, and absenteeism among Iraq war veterans. *American Journal of Psychiatry*, 164 (1), 150–153.
- Hoge, C., Auchterlonie, J. & Milliken, C. (2006). Military mental health problems: Use of mental health services, and attrition from military services after returning from deployment to Iraq or Afghanistan. *Journal of the American Medical Association*, 295(9), 1023-1032.

- Hoge, C. W., Castro, C.A., Messer, S. C., McGurk, D., Cotting, D.I., and Koffman, R. L. (2004). Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care. *New England Journal of Medicine*, 351(1),13-22.
<http://www.bmj.com/cgi/content/extract/334/7597/789> (accessed on 12 Aug 08).
- Iribarren, J., Paolo, P., Neagos, N. and Chiapelli, F. (2005). Post-Traumatic Stress Disorder: Evidence-Based Research for the Third Millennium. *eCAM 2005*; 2(4), 503-512.
- Karney, B. R., Ramchand, R., Chan, O. K., Caldarone, L. B. and Burns, R. M. (2008). Predicting the Immediate and Long-Term Consequences of Post-Traumatic Stress Disorder, Depression, and Traumatic Brain Injury in Veterans of Operation Enduring Freedom and Operation Iraqi Freedom. In Tanielian, T. & Jaycox, L.H.(Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 119-166). RAND Corporation.
- National Center for PTSD (Department of Veterans' Affairs). Treatment of PTSD. http://www.ncptsd.va.gov/ncmain/ncdocs/fact_shts/fs_treatmentforptsd.html (accessed on 31 Aug 08).
- Ramchand, R., Karney, B. R., Chan, O. K. , Caldarone, L. B. and Burns, R. M. (2008). Prevalence of PTSD, Depression, and TBI Among Returning Service members. In Tanielian, T. & Jaycox, L. H. (Eds.), *Invisible Wounds of War- Psychological & Cognitive Injuries, Their Consequences, & Services to Assist Recovery* (pp. 35-84). RAND Corporation.
- Rockswold, P.D., MD, MPH, MHS Medical Informatics Overview 2008 (16 Mar 08).
<http://www.nehc.med.navy.mil/presentations08/disease%20management/Medical%20informatics/080316-NMCPHC-%20Rockswold%20-MHS%20Medical%20Informatics%202008.ppt>. (assessed on 18 Oct 08).
- Schlenger, W. E. et al. (1999). Combat-Related Posttraumatic Stress Disorder: Prevalence, Risk Factors and Co-morbidity. In Saigh, P. A. & Bremner, J. D. (Eds.), *Post-traumatic Stress Disorder: A Comprehensive Text* (pp. 69-91). MA: Allyn & Bacon.

- Tanielian, T. & Jaycox, L. H., Adamson, D. M. and Metscher, K. N. (2008). *Invisible Wounds of War—Psychological and Cognitive Injuries, Their Consequences and Services to Assist Recovery*. RAND Corporation.
- Vasterling, J.J., Procter, S.P., Amoroso, P., Kane R., Heeren, T., White, R. F. (2006). Neuropsychological Outcomes of Army personnel deployment to the Iraq War. *Journal of the American Medical Association*, 296(5), 519-529.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California
3. Prof. Yu-Chu Shen
Naval Postgraduate School
Monterey, California
4. Prof. Jeremy Arkes
Naval Postgraduate School
Monterey, California